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CHARLOTTENLUND SLOT - DANEMARK

ANNALES BIOLOGIQUES

VOLUME NO. V

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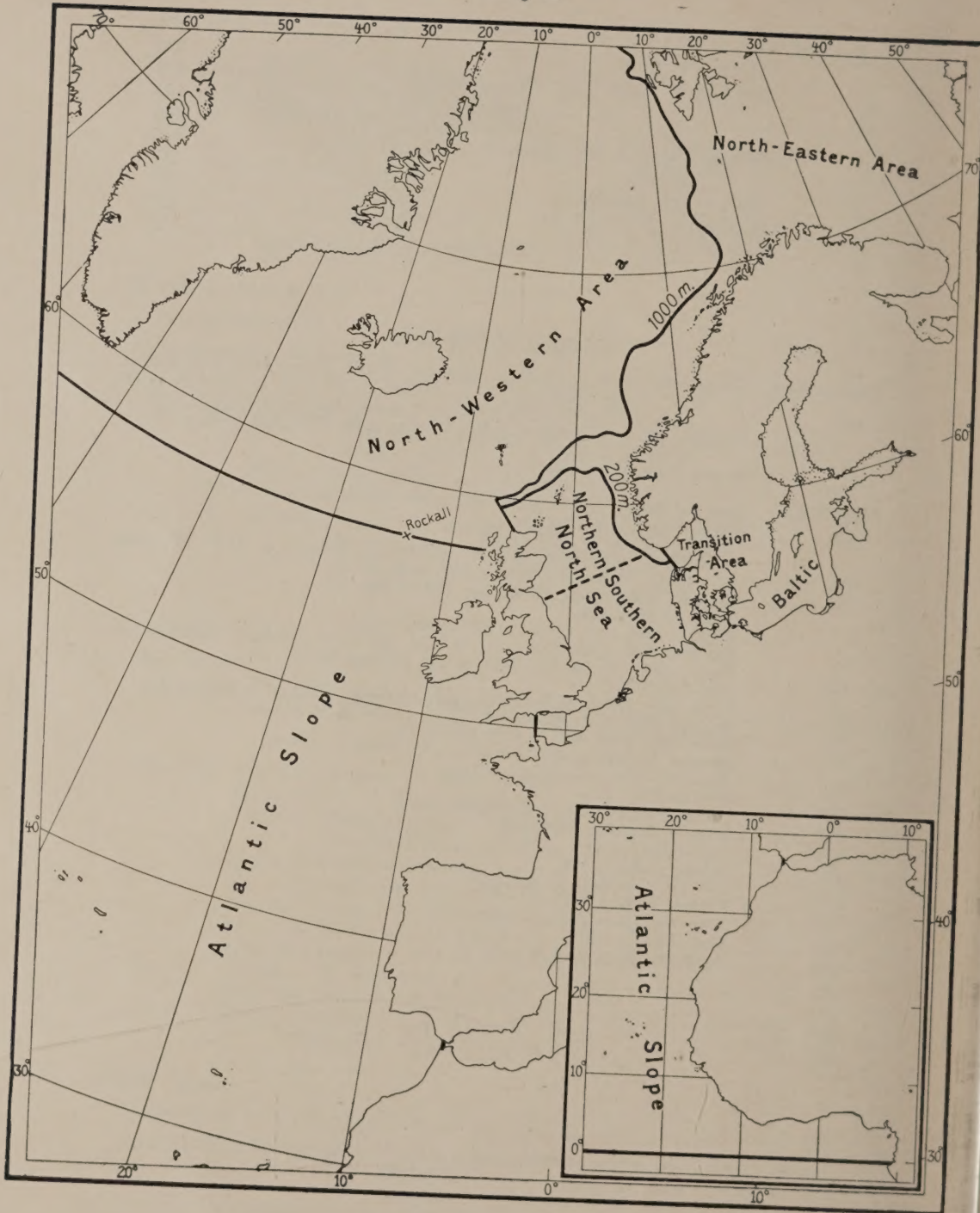
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The Areas and their Limits.
For the Transition Area see also the Map on p. 116.

North-Eastern Area.

France.

Rapport de Croisière de pêche (Morue) en Mer de Barentz - Juillet 1948.

Par

J. Ancellin.

NOUS avons participé en Juillet 1948 à une croisière de grande pêche, en Mer de Barentz, à bord d'un chalutier français ("le Rouget"), armé pour la pêche à la morue et parti de Boulogne s/Mer.

1. Caractéristique du navire, engin de pêche.

Le chalutier à vapeur "Rouget", d'une longueur de 55 mètres, jauge 485 tonnes.

L'engin de pêche était constitué par un chalut de 23 mètres d'ouverture (bourrelet). La dimension des mailles du filet était uniformément de 70 mm.

2. Lieux de pêche.

Les principaux lieux de pêche exploités se trouvaient aux positions suivantes:

	1	2	3
Lat. N.	71°13'	71°13' à 71°15'	71°50'
Long. E. Gr.	42°00'	42°50' à 43°10'	46°30'

Le chalutage s'est généralement pratiqué sur des fonds de 140 m. à 200 m. environ.

Les Conditions de Milieu.

1. Observations météorologiques.

Pendant toute la durée de la pêche le temps s'est maintenu au beau. Vent N. à NE., faible à modéré, mer généralement calme, ciel clair à 1/2 couvert. Température de l'air: +5° à +8° en moyenne.

2. Observations hydrologiques.

Chaque fois que cela nous a été permis nous avons procédé à des prélèvements d'eau et prises de températures à l'aide de la bouteille à renversement

Knudsen, et suivant des sections en profondeur (50, 100, 200 m.) sur les lieux de pêche:

	Lat. N.	Long. E. Gr.	m.	t °C.
a)	71°13'	42°00'	0	6.30
	le 11/7 à 12 heures.		20	5.40
			50	2
			100	1.80
b)	71°15'	42°10'	100	1.75
	le 15/7 à 17 heures.			
c)	71°14'	43°00'	0	6
	le 17/7 à 12 heures.		40	4.12
			50	2.15
			100	0.80
d)	71°50'	46°30'	0	5.20
	le 19/7 à 19 heures.		50	2.15
			100	1.25
			200	0.40
			(fond)	

3. Plancton.

Nous avons effectué des pêches journalières de plancton à l'aide d'un filet en nylon de 15 cm. de diamètre, remorqué en surface à la vitesse de chalutage (3 noeuds) pendant 1/4 d'heure.

Nous avons effectué en outre: une pêche de plancton en profondeur (200 m.) à l'aide du même filet, adapté à l'un des panneaux du chalut: durée de dragage: 2 heures; deux autres pêches en profondeur (une première section sur 100 m., une seconde sur 200 m.) à l'aide d'un filet en nylon de 33 cm. de diamètre, remonté lentement à bord, le bateau étant stoppé.

Les espèces ont été déterminées par Milles Fleury et Fortin.

Les résultats peuvent être ainsi résumés: le zooplancton est peu abondant; les Copépodes dominent, et parmi eux, *Calanus finmarchicus* Gunner. On trouve plus rarement *Oithona helgolandica* Claus et *Microsetella norvegica* Boeck. Des larves de Crustacés décapodes, quelques Mollusques hétéropodes (*Limacina helicina* Phipps), des larves de Lamellibranches, des Chaetognathes (*Sagitta elegans arctica* Aur.) ont également été capturés.

A signaler en outre quelques coques vides d'un Tintinnide que A. Meunier a mentionné en 1907 (Expédition de la "Belgica") sous le nom de *Cyrtocylis gigantea* Brandt.

Le phytoplancton recueilli dans les pêches planctoniques effectuées à bord du "Rouget" se montre d'une grande pauvreté en espèces et en quantité.

Il est caractérisé au point de vue des Péridiniens par la présence de *Ceratium arcticum* Ehr., espèce boréale habituelle dans ces parages, mais les pêches effectuées n'en ont recueilli que quelques échantillons. En outre signalons de rares *C. macroceros* Ehr. Il y a lieu de signaler également: *Halosphaera viridis* Schmitz, présent à peu près dans toutes les pêches, mais les exemplaires y étant toujours peu nombreux.

Les Diatomées se montrent encore plus rares; dans l'ensemble des pêches nous n'avons observé qu'un seul *Coscinodiscus oculisiridis* Ehr. et un seul *Coscinodiscus radiatus* Ehr.

Poissons et Invertébrés.

1. Morue.

a. Rendement.

La pêche (du 10/7 au 22/7) a porté exclusivement sur la morue. Les apports étaient de 10 à 15 tonnes par journée de pêche (pêche totale 150 tonnes) et le poisson, préalablement vidé, et en partie étêté, fut conservé en cale réfrigérée.

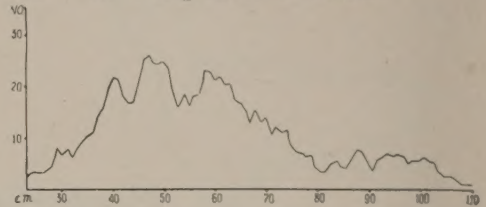
Au point de vue du rendement, d'assez importantes variations ont été enregistrées: c'est ainsi que les apports qui étaient en moyenne de 2 à 3 tonnes par trait de deux heures sont passés à plusieurs reprises à des quantités sensiblement plus importantes: 16 tonnes pour 2 traits consécutifs de 3 heures chacun dans la journée du 11/7 par 71°13' et 42°00'; 20 tonnes pour 2 traits consécutifs dans la journée du 20/7 par 71°50' et 46°30'; 15 tonnes pour 1 trait à cette même position dans la matinée du 21/7 et 10 tonnes pour 1 trait dans la journée du 22/7 par 71°13' et 42°50'.

D'une façon générale les poissons au dessous de 40/50 cm. qui ne convenaient pas pour la vente étaient rejetés à l'eau.

b. Mensurations.

Nous avons procédé à la mensuration de *Gadus morrhua* (N: 996). La courbe correspondant à des échantillons de 23 à 127 cm. comporte une série de sommets assez notables pour les longueurs voisines

de 30, 40, 50, 60, 70 cm. La courbe brute ainsi que la courbe rectifiée présentent un maximum vers 50 cm. (Voir le diagramme en annexe).



Gadus morrhua (Mer de Barentz, 1948.)
Répartition par tailles. (N = 996).

c. Observations biologiques.

Stade sexuel: III en moyenne.

Contenus stomacaux: présence fréquente de *Mallotus villosus*, de Cumacés divers et, suivant les endroits, de *Pandalus borealis*.

2. *Sebastes marinus*, Rot.

Observations biologiques.

Stade sexuel: III/IV.

3. Associations biologiques. Répartition et fréquence des espèces.

En ce qui concerne les vertébrés (poissons) les 9/10 de la faune étaient constitués par *Gadus morrhua*.

La présence de *Drepanopsetta platessoides*, *Anarhichas lupus*, *An. minor*, *Raia radiata* était assez fréquente ainsi que celle de *Sebastes marinus*; cette dernière espèce apparaissait toutefois très irrégulièrement. Nous avons relevé en outre la présence de quelques *Rheinhardtius hippoglossoides*, *Agonus decagonus*, *Cottunculus microps*; et enfin très rarement celle de *Gadus virens*, *Lumpenus maculatus*, *Cyclopterus lumpus*, *Cyclogaster gelatinosus* et *Laeomargus borealis*.

Parmi les invertébrés il y a lieu de signaler la présence assez fréquente et par places de Spongiaires (notamment par 71°50' et 46°30'), d'Echinodermes (*Solaster endeca*, *Urasterias lincki*, en particulier), et plus rarement: *Hippasteria plana*, *Solaster papposus*, *Pteraster pulvillus*, *Astropecten irregularis*, *Urasterias panopla*, *Henricia sanguinolenta*, *Ctenodiscus corniculatus*, *Gorgonocephalus eucnemis*, *Ophiura sarsi*, *Psolus phantapus* et *Cucumaria frondosa*.

Les Pantopodes (g. *Nymphon*) étaient parfois relativement fréquents. Le genre *Colossendeis proboscidea* fut plus rarement observé.

Les Crustacés étaient le plus souvent représentés par: *Hyas* (sp.) et *Pandalus borealis*. A signaler par places *Sabinea septemcarinata* et plus rarement *Eupagurus bernhardus*.

Les Mollusques n'ont été observés qu'en petit nombre (*Sipho islandicus*, *Neptunea despecta* et *Chlamys islandica*).

North-Western Area.

INTRODUCTION.

The contributors to this report from the North-Western Area are:

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Dr. J. H. Fraser and A. Saville, Aberdeen,
Dr. Paul M. Hansen, Copenhagen,
Cand. F. Hermann, Copenhagen,
Cand. Jón Jónsson, Reykjavik,
Cand. A. Kiilerich, Copenhagen,
Dr. Bennet B. Rae, Aberdeen,
Cand. Jens Smed, Copenhagen,
Cand. Unnstein Stefánsson, Reykjavik,
Cand. Helge Thomsen, Copenhagen.

1. Hydrography.

It should be emphasized that reviews of the hydrography of the North-Western Area are of special interest at present owing to the higher temperatures which have been observed during recent years, especially in Greenland waters. Though it has not been possible, in the present report, to review all the hydrographic sections worked during 1948, the hydrographical papers from the Faroe area, from North-Iceland waters and from the West-Greenland waters, give a good representation of the conditions in the area as a whole. Although, in general, "warm" conditions still dominate, the temperatures on the banks off the West-Greenland coast are slightly below the normal of recent years, and the conditions in North-Iceland waters show somewhat abnormal features. Only a few previous observations are available from the area round Disko, and it is accordingly of great value that some material from this little investigated area was secured in 1948; moreover, these observations ought to be continued because it is probable that changes may be most readily observed here. The movement of the warm Atlantic water round Disko should also be further

studied because of its influence on the dispersion of cod in these waters.

A strong influx of Atlantic water was observed in the Faroe-Shetland channel and north of the Faroes in August.

Mr. Jens Smed has continued the study of monthly anomalies in the surface temperature in the North Atlantic with a review of the conditions in the Faroe-Scotland area over a period of about 65 years.

2. Biology.

Information on the fish stocks of the area are restricted almost completely to the **cod** and the **lemon sole**.

Assessment of the adult cod stock in Faroe waters has not yet been possible since the war. There were great numbers of fry in 1948, but they were not so abundant as in 1947, which was the strongest brood-year ever recorded.

In Icelandic waters the 1936 year-class greatly outnumbered the three following year-classes, though they have entered the spawning stock. Cod marking experiments have now recommenced in Iceland waters after the war; 1200 specimens were liberated, mainly off the north coast.

In West-Greenland waters the 1934 and 1936 year-classes predominate in the commercial catches, especially the 1934 year-class, which has been the most important on record.

Observations on **lemon soles** are given as in previous years, and the survey of the Faroe stock shows a marked decrease in the stock, viz., a 23 % reduction per 100 hours fishing.

Some few observations on **haddock** and **saithe** fry in the Faroe waters and on **halibut** in Greenland waters are also reported.

Å. Vedel Tåning.

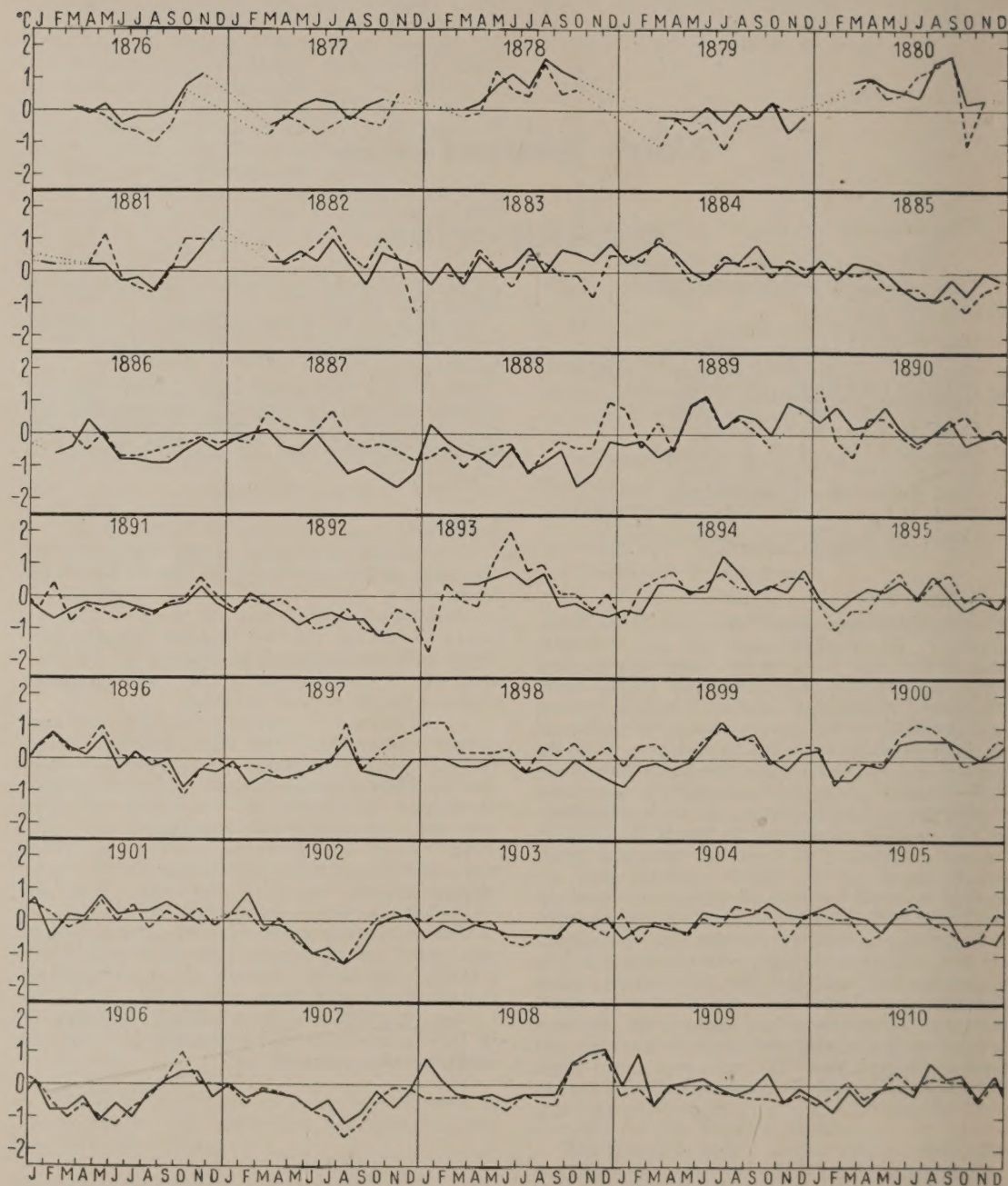
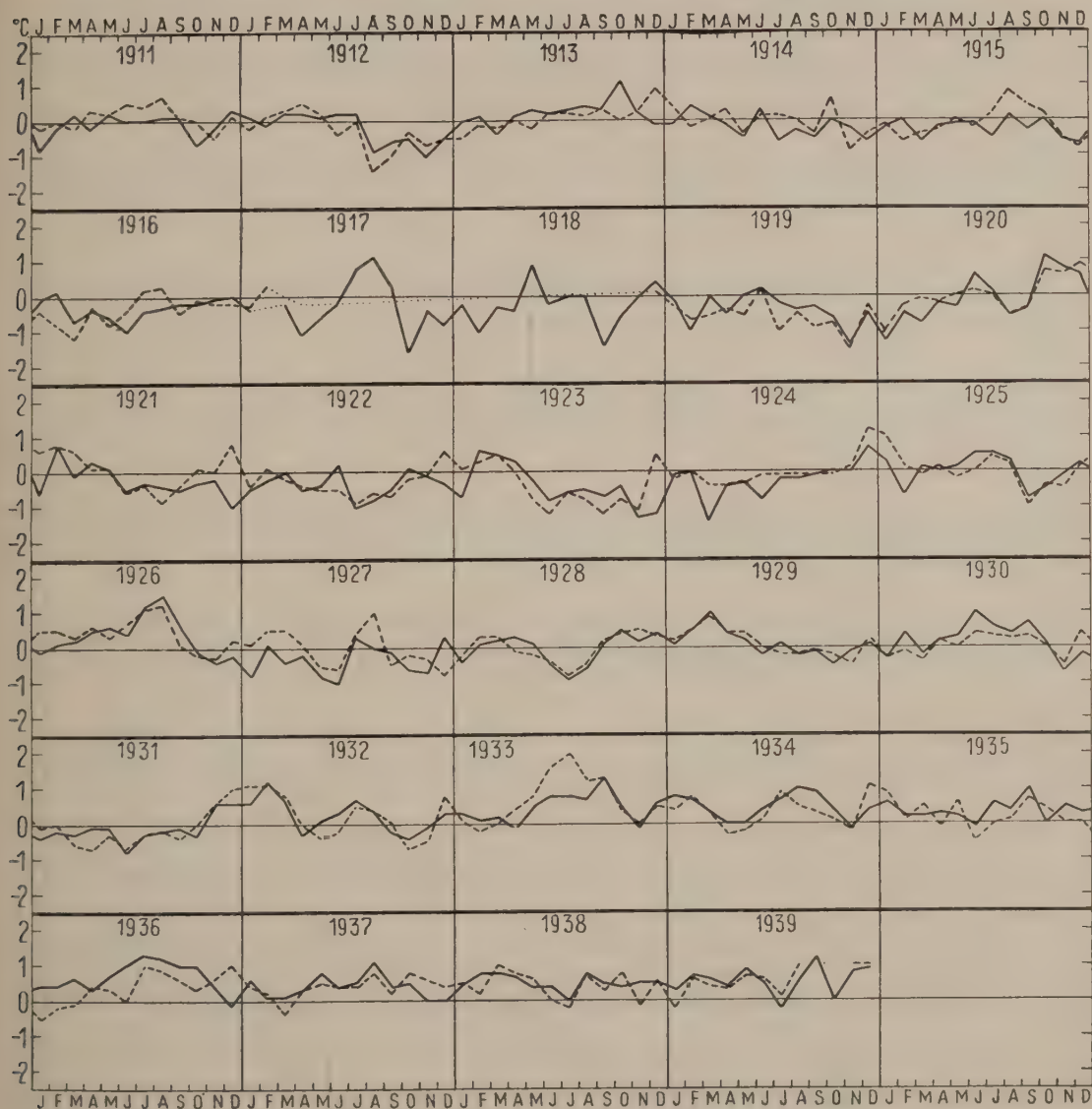


Fig. 1. Monthly anomalies of the surface temperature in the areas J and K (see Fig. 2)

ENVIRONMENT.

Hydrography.

Monthly Anomalies of the Surface Temperature in Areas of the North-Eastern North Atlantic during the Years 1876—1939 and 1945—1948.



during the years 1876—1939. Solid lines: area J; dashed lines: area K.

Table 1.

Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Area J
(see Fig. 2) during the Years 1896–1939. (1876–1895 see overleaf).

	January	February	March	April	May	June	July	August	September	October	November	December
	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	n	n	n	n	n	n	n	n	n	n	n	n
1896	0.4	4	0.3	33	0.1	176	0.7	90	0.2	104	0.0	60
1897	-0.1	7	-0.5	61	-0.6	120	-0.5	115	-0.4	97	-0.5	48
1898	0.0	6	-0.2	24	-0.2	148	0.0	125	-0.5	72	0.0	18
1899	-0.8	6	-0.2	5	-0.1	102	-0.1	102	0.2	109	0.6	97
1900	0.3	7	-0.6	53	-0.1	131	-0.2	117	0.6	91	0.6	105
1901	0.7	11	-0.5	8	-0.2	61	0.1	118	0.3	82	0.3	83
1902	0.3	9	-0.1	63	-0.1	107	-0.4	93	-0.8	62	-0.3	87
1903	-0.5	4	-0.1	7	-0.3	43	-0.1	82	-0.2	92	-0.4	56
1904	-0.5	3	-0.1	17	-0.1	72	-0.2	92	-0.3	75	0.2	69
1905	0.4	16	0.6	4	0.2	37	0.1	69	0.2	52	-0.7	30
1906	0.1	20	-0.8	35	-0.8	49	-0.4	126	-1.1	82	0.1	50
1907	0.0	23	-0.4	20	-0.2	58	-0.3	83	-0.4	64	-0.5	50
1908	0.8	5	0.1	17	-0.3	51	-0.4	65	-0.3	61	-0.3	62
1909	0.0	21	1.0	20	-0.6	27	0.0	69	-0.1	31	0.4	36
1910	-0.4	10	-0.8	22	-0.1	36	-0.6	71	-0.1	38	0.0	56
1911	-0.8	14	-0.2	21	0.2	31	-0.2	44	0.2	46	0.0	31
1912	0.1	196	-0.1	193	0.2	230	0.2	197	0.1	72	0.2	108
1913	0.0	198	-0.1	196	-0.4	250	0.1	92	0.3	78	0.2	63
1914	-0.1	11	0.4	42	-0.1	72	-0.5	53	-0.3	85	-0.6	76
1915	-0.2	26	0.0	70	-0.6	112	-0.2	127	-0.1	120	-0.5	56
1916	-0.1	46	0.1	19	-0.7	71	-0.4	77	-0.6	107	-0.4	131
1917	-0.4	22	—	—	-0.2	18	-1.1	60	-0.6	116	-0.2	70
1918	-0.2	7	1.0	27	-0.3	71	-0.4	60	0.9	81	-0.2	82
1919	-0.1	25	-1.0	18	-0.0	40	-0.5	44	0.0	89	-0.2	134
1920	-1.3	32	-0.5	11	-0.8	25	-0.2	24	-0.3	65	0.6	89
1921	-0.6	18	0.8	21	-0.1	81	0.3	124	0.1	79	-0.5	41
1922	-0.5	18	-0.2	18	0.0	20	-0.5	48	-0.4	47	-0.2	18
1923	-0.7	15	0.6	30	0.5	36	-0.3	42	-0.2	28	-0.8	42
1924	-0.1	20	0.0	47	-1.4	26	-0.4	54	-0.3	65	-0.8	68
1925	0.3	8	-0.7	17	0.1	39	0.0	57	0.1	46	0.5	40
1926	-0.1	44	0.1	28	0.2	44	0.5	69	0.6	68	0.4	111
1927	-0.8	57	0.1	69	-0.4	60	-0.2	51	-0.8	108	-1.0	60
1928	-0.4	64	0.1	94	0.2	105	0.3	110	0.1	128	-0.5	89
1929	0.1	51	0.5	52	1.0	91	0.4	97	0.2	85	-0.2	75
1930	-0.3	18	0.4	45	-0.2	86	0.2	77	0.3	81	1.0	100
1931	-0.4	52	-0.2	45	-0.3	81	-0.1	114	-0.1	90	-0.8	105
1932	0.6	38	1.2	26	0.7	33	-0.3	42	0.1	81	0.3	119
1933	0.3	42	0.1	48	0.2	67	-0.1	72	0.5	95	0.8	94
1934	0.8	30	0.7	38	0.3	69	0.0	73	0.0	90	0.4	77
1935	0.6	27	0.2	39	0.2	66	0.3	64	0.2	70	-0.1	59
1936	0.4	25	0.4	38	0.6	56	0.3	44	0.7	68	1.0	73
1937	0.6	33	0.1	21	0.1	28	0.3	46	0.8	58	0.4	62
1938	0.5	47	0.8	29	0.8	58	0.7	57	0.4	67	0.4	55
1939	0.3	39	0.7	26	0.6	48	0.4	60	0.9	63	0.5	57

Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Area K (see Fig. 2) during the Years 1896—1939. (1876—1895 see overleaf).

	January		February		March		April		May		June		July		August		September		October		November		December	
	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n
1896	0.3	27	0.7	37	0.2	38	0.3	34	1.0	40	0.1	81	0.0	67	0.0	36	-0.3	68	-1.1	48	-0.3	41	0.0	28
1897	-0.3	25	-0.2	33	-0.3	19	-0.6	68	-0.6	60	-0.2	47	-0.1	52	1.1	62	-0.3	55	0.2	56	0.6	30	0.8	23
1898	1.1	12	1.1	10	0.2	24	0.2	47	0.2	75	0.3	82	-0.4	72	0.4	99	0.1	84	0.5	71	0.0	46	0.4	29
1899	-0.2	29	0.4	15	0.5	35	0.0	55	0.0	55	0.7	51	1.0	64	0.7	53	0.6	57	-0.1	63	0.2	53	0.4	41
1900	0.4	8	-0.8	5	-0.1	31	-0.1	52	-0.1	69	0.7	59	1.1	47	1.0	67	0.6	85	-0.2	49	0.0	65	0.6	39
1901	0.5	38	0.2	29	-0.2	61	0.0	77	0.6	72	0.0	93	0.5	64	-0.2	72	0.3	88	0.0	67	0.4	48	-0.1	46
1902	0.2	41	0.3	29	-0.3	61	0.1	54	-0.6	91	-1.0	68	-1.1	67	-1.3	69	-0.4	95	0.1	47	0.3	45	-0.1	51
1903	0.0	30	0.3	29	-0.3	57	-0.1	43	0.0	66	-0.6	84	-0.7	112	-0.4	81	-0.5	71	0.1	49	-0.1	57	-0.4	55
1904	0.3	28	-0.6	50	0.0	63	-0.1	65	-0.4	68	0.1	76	-0.1	88	0.5	64	0.4	81	0.3	68	-0.6	55	0.1	60
1905	0.3	34	0.1	38	0.1	55	-0.6	44	-0.3	58	0.3	36	0.6	54	0.0	67	-0.2	52	-0.6	35	-0.5	42	0.3	34
1906	0.1	22	-0.5	36	-1.0	55	-0.6	55	-1.0	70	-1.2	73	-0.7	69	-0.4	68	0.1	71	1.0	51	0.1	44	0.0	31
1907	-0.1	11	-0.6	28	-0.1	42	-0.2	59	-0.4	91	-0.8	92	-1.0	69	-1.6	87	-1.2	67	-0.5	55	-0.1	59	-0.1	22
1908	-0.4	6	-0.4	29	-0.4	44	-0.4	38	-0.4	66	-0.8	56	-0.3	75	-0.5	69	-0.6	52	0.6	40	0.8	43	1.0	20
1909	-0.3	8	-0.1	25	-0.6	36	0.0	65	-0.3	74	0.0	63	-0.2	53	-0.3	66	-0.4	58	-0.4	75	-0.5	29	-0.3	24
1910	-0.6	14	-0.3	19	0.1	31	-0.4	51	-0.1	78	0.4	72	-0.1	66	0.2	59	0.1	65	0.1	45	-0.5	53	0.1	35
1911	-0.2	25	0.0	29	-0.2	32	0.3	56	0.2	83	0.5	66	0.4	75	0.7	70	0.1	82	0.0	41	-0.5	49	0.1	28
1912	-0.2	32	0.1	34	0.3	32	0.5	53	0.2	50	-0.4	102	0.0	68	-1.4	71	-1.0	76	-0.3	36	-0.7	51	-0.5	19
1913	-0.5	26	-0.1	37	-0.2	46	0.0	60	-0.2	75	0.2	89	0.2	89	0.2	60	0.3	58	0.0	63	0.2	50	0.9	20
1914	0.4	12	-0.2	20	0.0	33	0.3	53	-0.4	60	0.1	60	0.1	114	0.0	52	-0.4	25	0.6	24	-0.9	6	-0.4	4
1915	-0.1	21	-0.6	4	-0.4	24	-0.3	29	0.0	22	-0.2	34	0.1	46	0.8	52	0.4	35	0.2	59	-0.5	7	-0.8	14
1916	-0.4	20	-0.8	9	-1.2	22	-0.3	32	-0.8	32	-0.4	19	0.2	37	0.3	27	-0.5	34	-0.1	66	-0.2	27	-0.2	13
1917	-0.3	20	0.3	8	—	—	-0.2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1918	—	—	-0.7	18	-0.6	23	-0.4	36	-0.6	28	0.2	61	-1.0	34	-0.5	36	-0.9	21	-0.8	42	-1.5	53	-0.3	11
1919	-0.3	9	-0.3	22	-0.1	26	-0.2	47	0.0	5	0.1	15	0.0	68	-0.6	46	-0.4	42	0.7	91	0.6	30	0.9	15
1920	-1.0	39	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1921	0.6	5	0.8	19	0.6	20	0.1	42	0.1	41	-0.6	48	-0.4	46	-0.9	59	-0.4	43	0.1	51	0.0	48	0.8	16
1922	-0.4	21	0.1	11	-0.2	22	-0.4	42	-0.5	30	-0.5	56	-0.9	70	-0.6	39	-0.7	61	-0.2	63	-0.1	35	0.6	13
1923	0.1	21	0.3	21	0.5	42	0.0	49	-0.8	63	-1.2	54	-0.6	51	-0.8	34	-1.2	63	-0.8	52	-1.1	33	0.5	11
1924	-0.2	24	0.0	21	-0.4	32	-0.4	36	-0.3	74	-0.1	25	-0.1	54	-0.1	35	-0.1	54	-0.1	29	0.1	34	1.2	18
1925	1.0	23	0.1	35	0.1	44	0.1	51	-0.2	66	0.0	73	0.4	68	0.2	55	-1.0	24	-0.4	42	-0.5	44	0.1	21
1926	0.5	14	0.5	29	0.3	21	0.6	38	0.3	59	0.7	83	1.1	78	1.2	31	0.1	68	-0.2	42	-0.3	62	0.2	29
1927	0.1	24	0.5	21	0.5	25	0.1	24	-0.5	36	-0.6	29	0.4	51	1.0	39	-0.5	47	-0.2	43	-0.3	41	-0.8	24
1928	-0.2	26	0.3	46	0.3	45	-0.1	61	-0.2	72	-0.4	57	-0.8	69	-0.5	70	0.2	56	0.4	50	0.5	44	0.3	41
1929	-0.2	23	0.5	29	0.9	44	0.4	50	0.4	45	0.0	57	-0.2	59	-0.2	79	-0.1	88	-0.2	59	-0.5	38	0.3	38
1930	-0.3	28	-0.1	46	-0.4	50	0.2	78	0.0	63	0.4	60	0.3	75	0.2	67	0.3	66	0.0	81	-0.5	48	0.4	34
1931	-0.1	26	0.0	31	-0.6	41	-0.7	32	-0.3	56	-0.7	46	-0.3	37	-0.2	60	-0.4	40	0.0	51	0.6	15	1.0	18
1932	1.1	9	1.1	19	0.8	26	0.0	40	-0.4	49	-0.2	43	0.5	28	0.4	27	0.0	40	-0.7	39	-0.5	30	0.8	11
1933	0.1	25	-0.2	16	0.0	12	0.4	41	0.8	58	1.6	29	2.0	27	1.2	31	1.3	37	0.4	40	0.0	29	0.5	23
1934	0.4	17	0.8	21	0.3	32	-0.3	45	-0.2	35	0.1	46	0.9	32	0.5	29	0.3	36	0.1	41	-0.2	25	1.1	3
1935	0.9	16	0.1	17	0.5	25	-0.1	27	0.6	27	-0.5	19	0.0	33	0.1	37	0.7	36	0.4	22	0.0	16	0.0	20
1936	-0.5	9	-0.2	19	-0.1	33	0.4	35	0.3	60	0.0	25	1.0	44	0.9	23	0.6	49	0.3	17	0.6	20	1.0	10
1937	0.4	22	0.2	24	-0.4	29	0.3	42	0.5	52	0.4	47	0.4	47	0.8	34	0.2	35	0.8	15	0.6	41	0.4	19
1938	0.5	22	0.2	19	1.0	27	0.8	46	0.6	41	0.0	36	-0.2	31	0.7	32	0.3	16	0.8	18	-0.1	31	0.6	29
1939	-0.2	12	0.6	22	0.4	18	0.3	42	0.7	30	0.6	12	0.1	24	1.0	26	—	—	—	—	1.0	11	1.0	1

Tables 1a & 2a. Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Areas J and K (see Fig. 2) during the Years 1876-1895. (1896-1939 see preceding pages).

Area J.	January		February		March		April		May		June		July		August		September		October		November		December	
	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n
1876	—	—	—	—	—	—	-0.1	103	0.2	46	-0.4	74	-0.2	19	-0.2	31	0.0	75	0.8	41	1.1	13	—	—
1877	—	—	—	—	-0.5	10	-0.3	49	0.1	32	-0.3	21	0.2	40	-0.3	10	0.1	48	0.3	28	—	—	—	—
1878	—	—	—	—	0.0	4	0.2	34	0.8	21	1.1	13	0.7	20	1.6	16	1.2	20	1.0	11	—	—	—	—
1879	—	—	—	—	-0.2	4	-0.2	18	-0.3	49	0.1	11	-0.4	13	0.2	21	-0.2	16	0.3	3	-0.7	5	-0.2	2
1880	—	—	—	—	0.9	5	1.0	68	0.7	62	0.6	31	0.4	22	1.5	46	1.7	54	0.2	15	0.3	11	—	—
1881	0.3	7	0.2	2	—	—	0.2	53	0.2	76	-0.3	30	-0.2	56	-0.6	21	0.1	55	0.1	50	0.8	17	1.4	6
1882	—	—	—	—	0.3	68	0.3	144	0.6	46	0.3	25	1.0	31	0.3	31	-0.4	74	0.6	50	0.4	48	0.2	35
1883	-0.4	5	0.3	7	-0.4	22	0.5	181	0.0	122	0.2	82	0.8	31	0.0	43	0.7	113	0.6	60	0.4	28	0.9	7
1884	0.3	6	0.6	7	0.9	29	0.6	92	0.0	111	-0.2	112	0.3	67	0.3	70	0.9	68	0.2	82	0.2	28	-0.1	13
1885	0.4	6	-0.2	3	0.3	39	0.2	131	0.0	105	-0.5	58	-0.8	64	-0.8	53	-0.2	106	-0.7	61	0.0	69	-0.2	12
1886	—	—	-0.6	12	0.4	7	0.4	144	-0.1	70	-0.8	33	-0.8	50	-0.9	64	-0.9	79	-0.5	54	-0.2	23	-0.5	4
1887	-0.2	2	0.0	19	0.1	36	-0.4	139	-0.5	70	0.0	65	-0.6	65	-1.2	35	-1.0	56	-1.3	42	-1.6	22	-1.2	5
1888	0.3	7	-0.2	7	-0.5	10	-0.6	37	-1.0	142	-0.4	29	-1.1	33	-0.9	57	-0.5	54	-1.6	44	-1.2	35	-0.2	15
1889	-0.3	9	-0.2	8	-0.7	12	-0.4	74	0.9	66	1.2	49	0.2	44	0.6	35	0.5	57	0.0	49	1.0	10	0.8	6
1890	0.4	6	0.9	6	0.2	29	0.3	101	0.9	84	0.2	77	-0.2	30	0.0	78	0.5	43	-0.3	8	-0.1	22	0.0	7
1891	-0.4	7	-0.7	7	-0.4	37	-0.2	142	-0.3	109	-0.2	63	-0.3	70	-0.5	75	-0.3	75	-0.2	35	0.3	41	-0.2	15
1892	-0.5	5	0.1	5	-0.2	11	-0.5	156	-0.9	48	-0.6	39	-0.5	56	-0.7	62	-0.7	57	-1.2	55	-1.1	25	-1.4	8
1893	—	—	—	—	0.4	11	0.4	90	0.6	106	0.8	91	0.4	66	0.7	82	-0.3	62	-0.2	30	-0.5	12	-0.6	3
1894	-0.4	6	-0.5	5	0.4	36	0.4	124	0.2	70	0.2	97	1.3	51	0.8	50	0.1	49	0.4	19	0.2	24	0.9	7
1895	0.0	7	-0.4	7	0.0	9	0.3	162	0.2	131	0.5	133	0.0	86	0.7	79	0.1	96	-0.4	32	-0.1	18	-0.3	6

Area K.																								
1876	—	—	—	—	0.1	2	0.0	10	-0.2	17	-0.6	20	-0.7	9	-1.0	2	-0.5	14	0.6	21	—	—	—	—
1877	—	—	—	—	-0.8	14	-0.2	13	-0.4	33	-0.8	6	-0.5	31	-0.2	10	-0.4	19	-0.5	10	0.5	7	—	—
1878	—	—	—	—	-0.2	3	-0.1	32	1.2	26	0.6	12	0.4	16	1.4	12	0.5	26	0.6	22	—	—	—	—
1879	—	—	—	—	-1.1	11	-0.2	18	-0.7	34	-0.4	24	-1.2	8	-0.3	14	-0.2	27	0.2	4	0.0	1	—	—
1880	—	—	—	—	0.5	10	1.0	11	0.4	40	0.5	29	1.1	30	1.3	14	1.7	31	-1.1	5	0.3	8	—	—
1881	0.5	2	—	—	—	—	0.2	17	1.1	18	-0.2	32	-0.5	20	-0.7	18	0.0	29	1.0	19	1.0	4	—	—
1882	—	—	—	—	0.8	8	0.2	48	0.4	24	0.8	41	1.4	19	0.5	26	0.1	52	1.0	12	0.4	4	-1.3	6
1883	—	—	-0.1	1	-0.2	6	0.7	21	0.1	25	-0.5	50	0.4	24	0.3	20	-0.1	42	-0.1	34	-0.8	6	0.5	12
1884	0.5	8	0.3	13	1.1	21	0.4	33	-0.3	26	-0.2	67	0.5	31	0.2	35	0.3	38	-0.1	45	0.4	15	0.1	21
1885	0.2	15	0.1	22	-0.1	25	0.0	36	-0.5	73	-0.5	25	-0.5	36	-0.9	24	-0.7	49	-1.2	26	-0.6	17	-0.4	16
1886	—	—	0.0	5	0.0	5	-0.5	26	0.0	36	-0.7	35	-0.7	61	-0.6	25	-0.4	43	-0.3	72	-0.1	24	-0.3	12
1887	-0.2	21	-0.3	8	0.7	24	0.3	25	0.1	30	0.1	64	0.7	31	-0.1	22	-0.4	47	-0.3	41	-0.5	20	-0.8	20
1888	-0.7	8	-0.4	11	-1.0	16	-0.6	27	-0.4	46	-0.3	52	1.2	50	-0.6	38	-0.2	43	-0.4	21	-0.4	28	1.0	10
1889	0.8	14	-0.4	6	0.4	14	-0.5	13	0.9	27	1.1	29	0.2	14	0.5	27	0.1	45	-0.4	11	—	—	—	—
1890	1.4	5	-0.2	5	-0.7	19	0.5	22	0.5	43	0.0	44	-0.4	24	0.0	46	0.3	51	0.6	22	-0.1	17	0.2	12
1891	-0.4	12	0.4	5	-0.8	14	-0.3	32	-0.5	68	-0.7	51	-0.4	36	-0.6	44	-0.2	68	-0.1	33	0.6	38	0.0	18
1892	-0.4	12	-0.1	11	-0.2	14	-0.1	37	-0.5	36	-1.0	58	-0.9	39	0.4	37	-1.0	66	-1.2	39	-0.4	38	-0.6	33
1893	-1.7	7	0.4	4	-0.1	25	-0.3	40	1.1	68	2.0	32	-0.8	48	1.0	30	0.1	75	0.1	51	-0.4	30	0.1	38
1894	-0.8	10	0.3	26	0.6	24	0.8	46	0.1	49	0.4	58	0.8	33	0.3	30	0.2	33	0.3	35	0.6	27	0.6	22
1895	-0.2	16	-1.0	11	-0.4	19	-0.4	41	0.3	54	0.8	74	-0.1	41	0.4	56	0.7	78	-0.1	35	0.2	44	-0.3	34

Table 3. Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Number (n) of Observations of the Surface Temperature in the Areas J and K (see Fig. 2) for the Period July 1945—December 1948.

	1945		1946		1947		1948			1945		1946		1947		1948	
	Δ	n	Δ	n	Δ	n	Δ	n		Δ	n	Δ	n	Δ	n	Δ	n
Area J.									Area K.								
January	—	—	0.7	25	1.2	19	—0.1	26	January	—	—	1.2	6	0.7	28	0.6	23
February	—	—	1.2	5	1.0	21	1.0	27	February	—	—	1.0	6	0.1	18	0.7	17
March	—	—	0.9	17	0.4	52	0.8	47	March	—	—	1.3	12	—0.2	12	0.8	32
April	—	—	0.3	98	0.1	27	0.7	48	April	—	—	—	—	0.2	28	1.1	18
May	—	—	0.8	43	0.8	40	0.9	50	May	—	—	0.9	13	0.3	31	0.7	34
June	—	—	0.6	52	0.4	93	0.6	75	June	—	—	0.2	21	0.6	40	0.4	54
July	0.1	45	0.9	37	1.8	95	0.2	78	July	—	—	0.0	30	0.9	21	—0.2	35
August	2.0	9	0.9	46	1.9	41	0.3	91	August	—	—	0.8	21	1.9	21	—0.1	22
September	1.0	31	0.4	56	1.1	75	0.2	70	September	—	—	0.8	33	1.6	20	—0.2	45
October	2.0	19	1.1	82	0.8	30	0.3	57	October	1.5	7	0.7	42	0.8	23	—0.3	29
November	1.3	25	1.0	32	0.6	54	0.4	47	November	—	—	1.5	14	0.4	39	0.0	13
December	1.2	17	1.1	39	0.7	43	1.0	43	December	1.4	6	0.8	38	1.1	23	1.6	23

In previous reports (Smed, 1947, 1948, 1949a) monthly anomalies of the surface temperature during a period of years were given for various areas of the northern North Atlantic. In the present report these investigations are extended to two areas in the Faroe-Scotland region.

The areas dealt with are (see Fig. 2): J, 60° — 64°N. , 0° — 10°W. ; and K, 58° — 60°N. , 3° — 10°W. The data used have been collected by the Danish Meteorological Office. The data for the years 1912—1948 were compiled from the *Nautisk-Meteorologisk Aarbog*, while the data for the years 1876—1911 were kindly placed at my disposal by Mr. Helge Thomsen, Head of the Nautical Section of the Danish Meteorological Office.

The data available were temperature means for

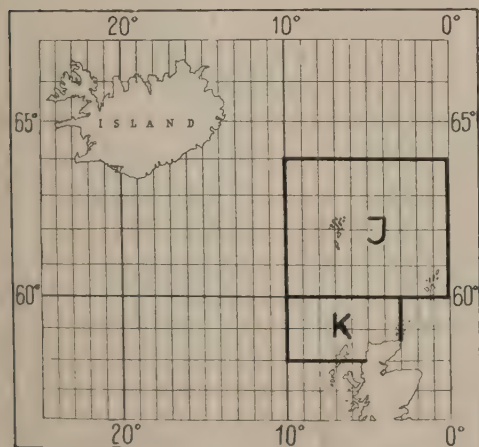


Fig. 2. Location of the areas considered.

each month and each 1° -square. These means have been compared with the grand monthly means for the period 1876—1915, published by Ryder (1917). The anomalies computed in this way were then averaged over each of the areas J and K. The reader is referred to the previous reports cited above for details of the calculation.

The results are given in Tables 1 and 2 where the monthly anomalies are recorded together with the number of observations on which they are based. A graphic presentation of the results is given in Fig. 1. This figure shows a high degree of conformity between the variations in the surface temperature in the two areas. Another conspicuous feature is the predominance of positive anomalies in the later part of the period, i.e., from about 1932. This is in accordance with the conditions found in areas of the northern North Sea (Smed, 1949b).

While no observations from the areas considered are available for the war years there are some data for the post-war years. On the basis of these data the anomalies recorded in Table 3 were calculated. It will be seen that positive anomalies are still highly predominant.

Thanks are due to Mrs. Poula Holm and Mr. P. Alnøe for making the calculations.

Literature.

- Nautisk-Meteorologisk Aarbog, 1912—1948. København.
 Ryder, 1917. Monthly Mean Temperatures of the Surface Water in the Atlantic, North of 50°N. Lat. (App. to Naut.-Meteor. Aarbog). Copenhagen.
 Smed, 1947. Annales Biologiques, Vol. II, p. 17.
 Smed, 1948. Annales Biologiques, Vol. III, p. 12.
 Smed, 1949a. Annales Biologiques, Vol. IV, p. 11.
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Jens Smed.

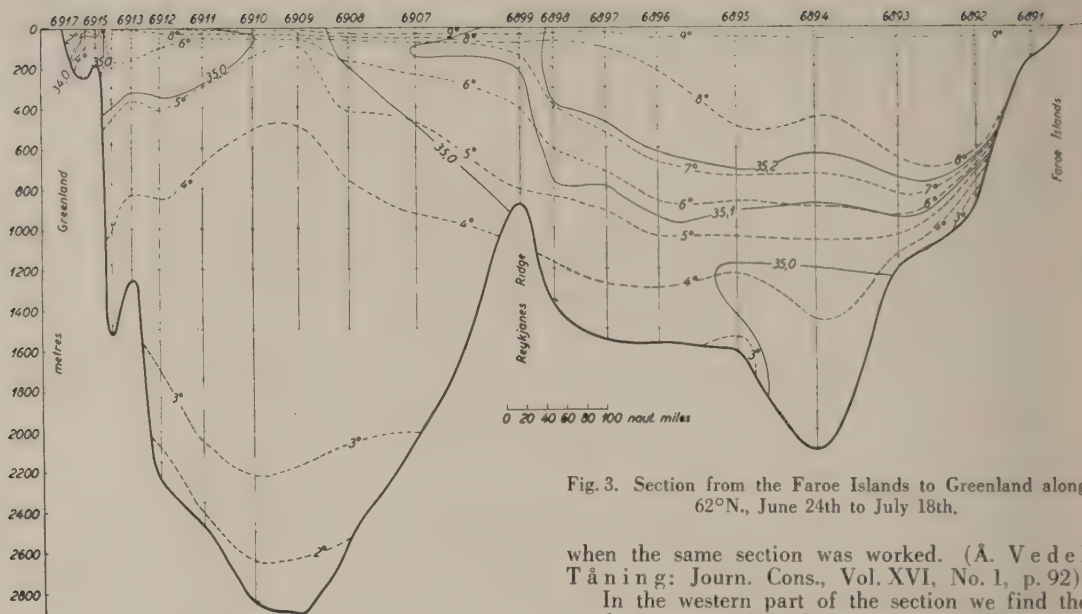


Fig. 3. Section from the Faroe Islands to Greenland along 62°N., June 24th to July 18th.

Section from the Faroes to East Greenland.

Fig. 3 shows the section worked from the R/V "Dana" during June 24th to July 18th, 1948.

The very pronounced difference between the hydrographic conditions of the area east of the Reykjanes Ridge and the area west of this ridge is clearly shown in the figure. The characteristic feature of the basin between the Faroes and the Reykjanes Ridge is the thick layer of nearly homogeneous water with a high temperature and salinity. Near the bottom, especially in the eastern part of the section, some low temperatures indicate that an outflow over the Faroe-Iceland Ridge of arctic bottom water must have occurred. The distribution of temperature and salinity east of the Reykjanes Ridge is very similar to that found in 1938 and in 1947,

when the same section was worked. (Å. Vedel Tåning: Journ. Cons., Vol. XVI, No. 1, p. 92).

In the western part of the section we find the northgoing part of the Irminger current and east of the slope off East Greenland the southgoing part of this current. The East Greenland polar current is at this season restricted to a narrow strip about 10 miles broad along the coast.

Comparison with the conditions found on the "Meteor" Expedition of August 1929 and August 1930 (Veröff.: Inst. Meereskunde, Reihe A, No. 32), shows that the thickness and degree of penetration of warm and saline water of Atlantic origin into the Irminger Sea was considerably smaller in 1948 than in the years 1929—30.

Frede Hermann.

Influx of Atlantic Water north of Iceland 1948.

During the first half of July and August extensive hydrographical investigations were carried out

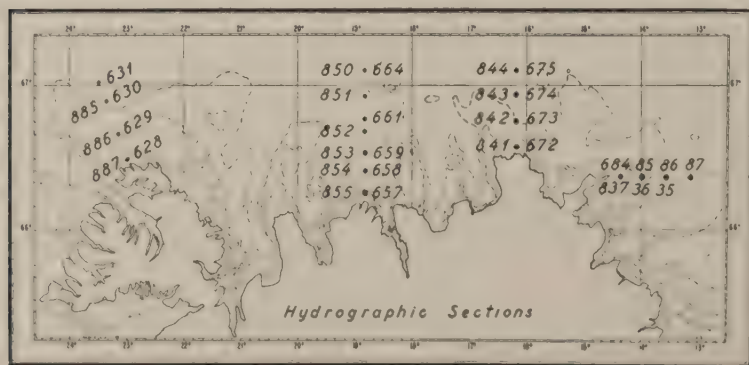


Fig. 4. Location of the Hydrographic Sections worked at North Iceland during the first half of July and August.

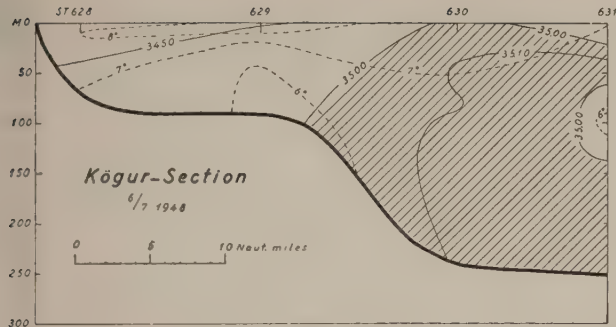


Fig. 5 a. Kögur Section, July.

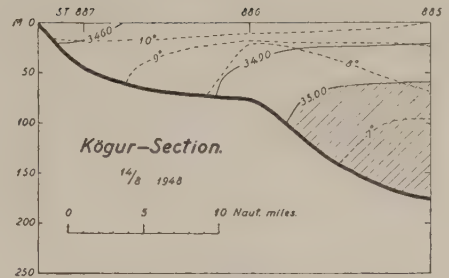


Fig. 5 b. Kögur Section, August.

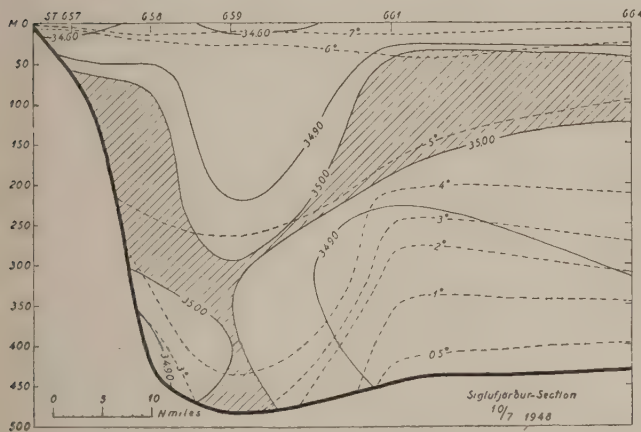


Fig. 6 a. Siglufjörður Section, July.

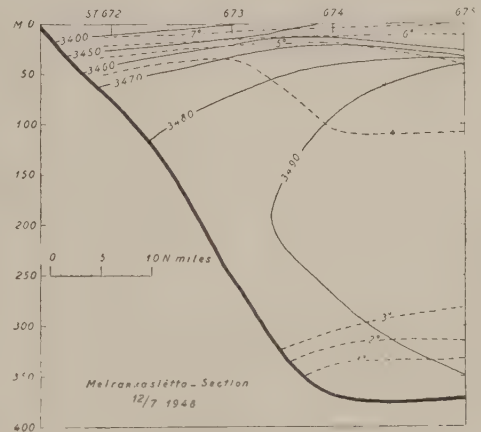


Fig. 7 a. Melrakkasletta Section, July.

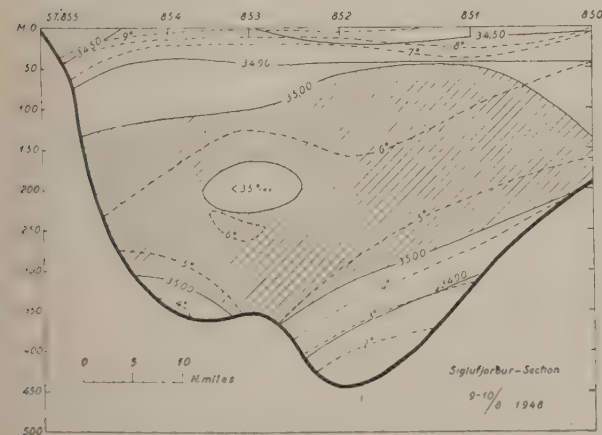


Fig. 6 b. Siglufjörður Section, August.

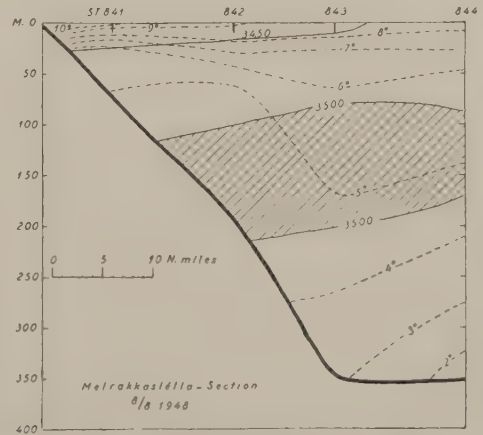


Fig. 7 b. Melrakkasletta Section, August.

Figs. 5—8. Hydrographic Sections, worked (a) in July, (b) in August.

in the waters north of Iceland. Figure 4 shows the location of the stations in the sections discussed in this paper.

Figures 5a—8a show the hydrographical situation during the first half of July. In the Kögur section Atlantic water extended from surface to bottom at the two outermost stations. The Siglufjörður section has a very peculiar and unusual appearance. At the two outermost stations in this section the deeper layers are mixed with Arctic bottom water. Atlantic water did not extend as far as Melrakkaslétta during this period.

Figures 5b—8b show the situation during the second week of August. In the Siglufjörður section and the Melrakkaslétta section the Atlantic water was observed as an intermediate layer, in the former between 100 and 300 metres and in the latter between 100 and 200 metres. The temperature in the deeper layers and at the bottom had increased considerably. Atlantic water, however, did not reach as far as Langanes in August, the temperature and salinity being even lower in the deeper layers than they were in July.

For comparison with earlier years, we refer to Tåning's report in *Ann. Biol.*, Vol. I, p. 81—82 and Einarsson's report, *ibid.*, Vol. IV, p. 10—11.

Unnsteinn Stefánsson.

Hydrographic Conditions North of Iceland, July 1948.

During 26th to 29th July 27 hydrographic stations (Fig. 9) were worked in the waters north of Iceland from the Danish research vessel "Dana" under the leadership of Dr. Å. Vedel Tåning.

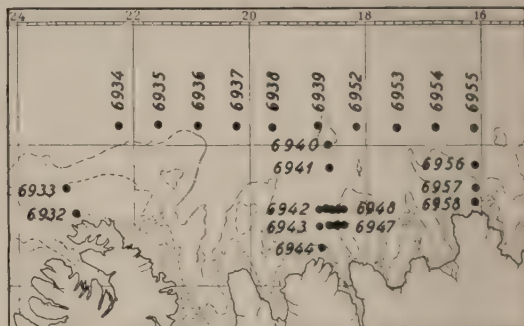


Fig. 9. Location of Stations.

Fig. 10 shows a section along latitude 67°07'N. Atlantic water with a salinity exceeding 35.0 ‰ was observed at all stations west of longitude 18° 30'. Very little Atlantic water was found east of this longitude.

Fig. 11 shows the Siglufjord section extended to Lat. 67°00'N. The distribution of Atlantic water is very near the mean for June—August 1924—1933. The discontinuity layer at 25 m. depth is more pronounced than in the section worked 20.7.1947. (H. Einarsson, *Ann. Biol.*, Vol. IV.).

Fig. 12 a and b illustrates the very well defined boundary of the Atlantic water towards the east. At station 6942 was found a layer of water 200 m. deep with salinity exceeding 35 ‰, but at station

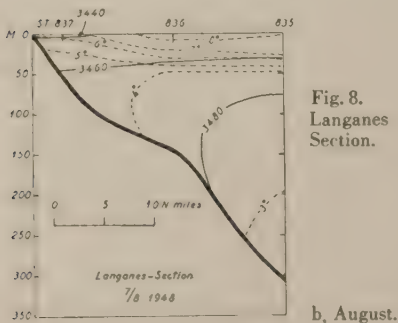
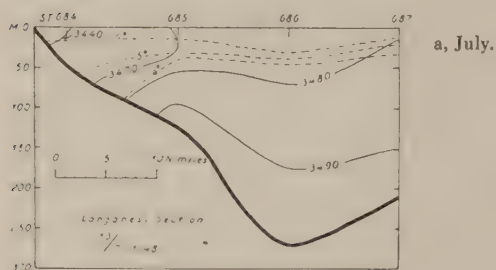


Fig. 8.
Langanes
Section.

b, August.

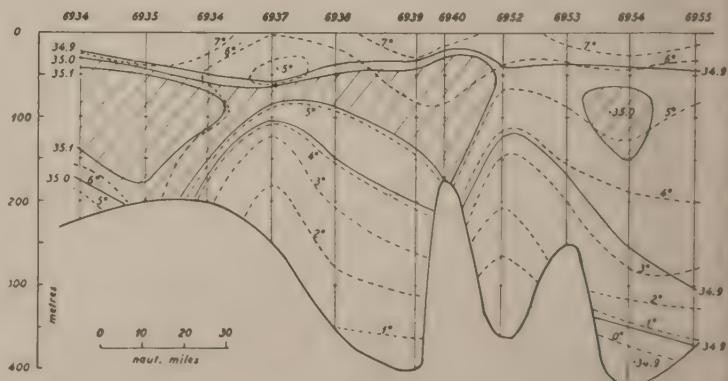


Fig. 10. Section along 67°07'N., July 26th to 29th.

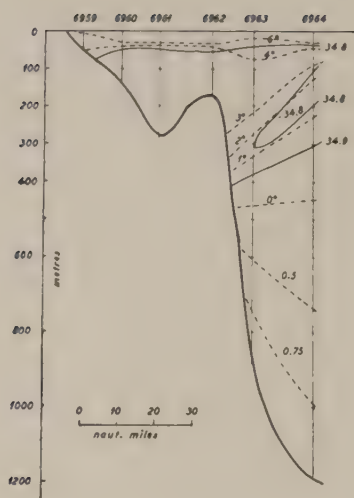


Fig. 17. Langesund Section,
July 29th to 30th.

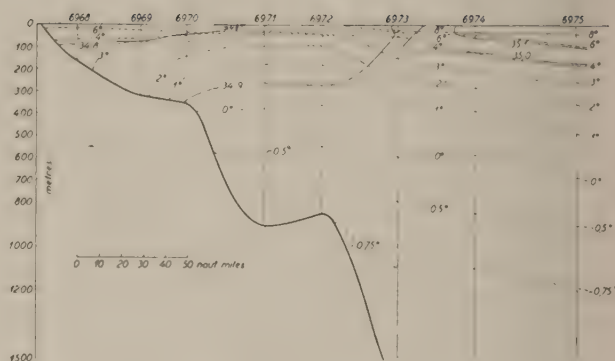


Fig. 18. Seydisfjord Section, July 31st to August 1st.

Table 4.

I. Seydisfjord section: positive values indicate watertransport northwards.

Station nos.	6968	6969	6970	6971	6972	6973	6974	Total
	6969	6970	6971	6972	6973	6974	6975	
Watertransp. km ³ /h.	-0.7	-1.3	-1.6	+0.3	+5.5	+0.6	+3.5	+6.3

In sections II—V, positive values indicate inflow into the Norwegian Sea.

II. Section from the Faroes northwards.

Station nos.	6991	6989	6980	6979	6978	6977	6976	6975	Total
	6992	6991	6989	6980	6979	6978	6977	6976	
Watertransp. km ³ /h.	+1.2	+0.7	+5.4	+10.6	+2.3	+1.1	-2.8	-2.4	+16.1

III.

Station nos.	6991	6990	6982	6983	6975	Total
	6992	6991	6990	6982	6983	
Watertransp. km ³ /h.	+1.2	+8.5	+5.3	-0.5	-1.0	+13.5

IV.

Station nos.	7004 6994	6994 6995	6995 6996	6996 6997	6997 6983	6983 6975	Total
Watertransp. km ³ /h.	+0.6	+1.0	+2.1	+0.3	+3.4	—1.0	+6.4

V. Faroe—Shetland Channel.

Station nos.	7004	7005	7006	7007	7008	7009	7010	7011	7014	Total
	7005	7006	7007	7008	7009	7010	7011	7014	7015	
Watertransp. km ³ /h.	-0.3	-0.2	+0.1	-2.0	+2.3	-3.8	+7.8	+12.2	0.0	+16.1

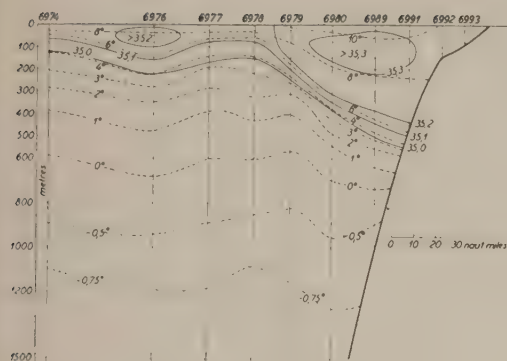


Fig. 19. Section from the Faroes northwards, August 1st to 5th.

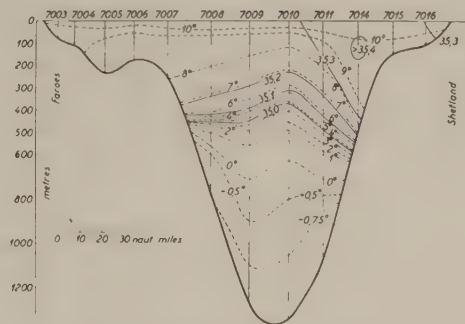


Fig. 20. Faroe—Shetland Section, August 12th to 14th.

The hydrographic conditions are further illustrated by the sections Figs. 17, 18, 19 and 20.

Dynamic calculations were carried out and Fig. 21 gives the dynamic topography of the surface relative to the 1000 decibar surface. At stations with depth less than 1000 metres the dynamic height was found by integrating $\alpha \cdot \Delta p$ along the bottom from a deeper station. As this operation is rather uncertain the topography of areas with moderate depth must be accepted with caution. It was found that no essential difference resulted from using the 1500 instead of the 1000 decibar surface as the reference surface. The water transport through different sections was calculated, assuming the current to be zero at 1000 metres, or at the bottom for depths less than 1000 metres. The results are given in Table 4.

From these values we get the following values

for the inflow into the Norwegian Sea between Iceland and the Faroes: Through section I + II: 22.4 km³/h., through I + III: 19.8 km³/h. and through I + IV: 12.7 km³/h.

The agreement between these values is not good, but they show that the inflow north of the Faroes is of the same magnitude as the inflow through the Faroe—Shetland Channel.

Frede Hermann.

Temperature and Salinity in the permanent sections off the west coast of Greenland, 1948.

Of the four permanent sections three were worked by the Royal Danish Survey Ship "Heimdal" as follows:

- Section off Frederikshaab: May
- " across "Fyllas Banke" (off Godthaab): May, September
- " across "Store Hellefiskebanke" (off Holsteinsborg): July, September.

A comparison with the observations of previous years indicates that the temperatures in the summer of 1948 were neither extremely high nor extremely low, though they were slightly below normal.

Section off Frederikshaab (Figure 22).

This section was worked on 24th May. On the eastern side of the section temperatures between 1°C. and 0.6°C. marked the arctic component of the West Greenland Current. The deeper part of the section, especially the western end, was occupied by water of Atlantic origin, having temperatures between 4°C. and 4.7°C. Compared with a section worked by the "Dana" on 10th July 1925 the temperatures in 1948 were higher throughout, in spite of the fact that the measurements were made 1½ months earlier than those of 1925.

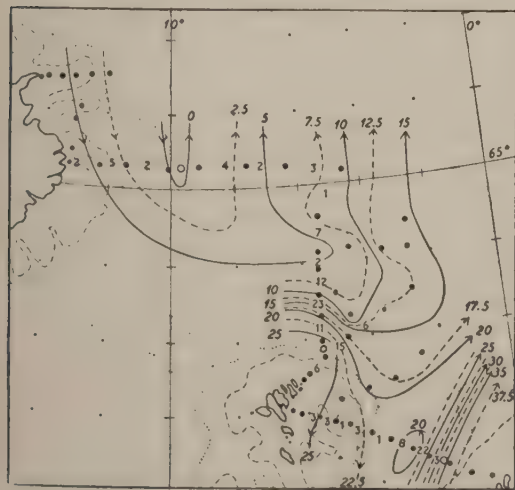


Fig. 21. Topography in dyn. cm., surface relative to 1000 metres, figures between the stations show the velocity in cm./sec.

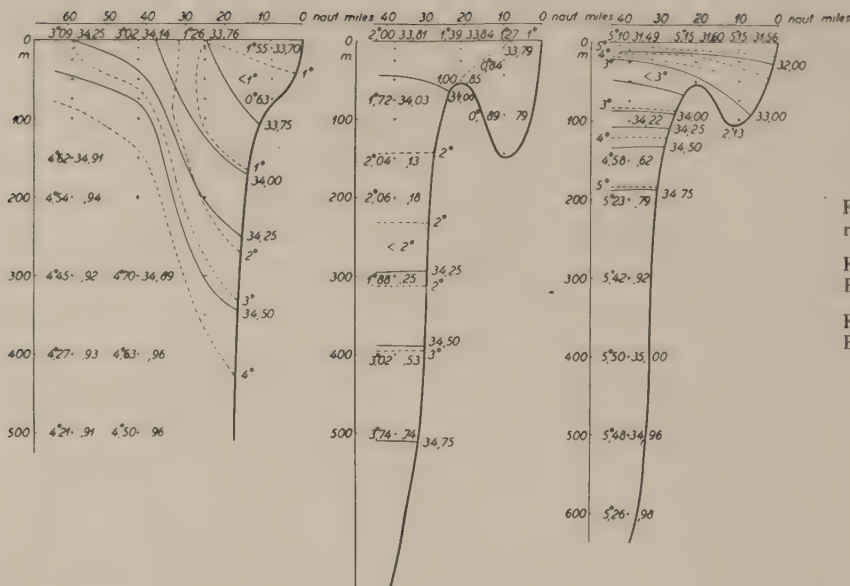


Fig. 22.

Fig. 23.

Fig. 24.

Fig. 22. Section off Frederikshaab, May 24th 1948.

Fig. 23. Section across Fyllas Banke, May 29th 1948.

Fig. 24. Section across Fyllas Banke, September 14th 1948.

Sections across "Fyllas Banke" (Figures 23 and 24).

This section was worked twice, on 29th May and 14th September. On the middle of the bank the temperature by the end of May was 1.39° at the surface, decreasing to 1.00° at the bottom, which is about 2.4° lower than observed on 13th June of the preceding year and about 0.6° lower than the average for June based on observations in the years 1925, 1934, 1936, 1937, 1938, 1947 and 1948. Of these seven years, 1938 showed the lowest temperature (0.22° to -0.04°) and is followed, in order of increasing temperature, by the years 1925, 1948, 1937, 1936, 1934 and 1947, the temperature reaching, in the last of these, the range 4.05 to 3.39 .

In September the summer heating had increased the temperatures on the bank by nearly 4° at the surface and by 1.4° at the bottom (50 m.). The bottom temperature, 2.38° , however, was still lower than in the years 1947, 1937, 1934, 1936 and 1946, and higher only than in the years 1924 and 1938. The surface temperature of 5.15° was high, the highest, in fact, of all the years for which records are available, except 1936.

The most striking feature seen when comparing the May and September sections is the change which had taken place in the deeper layers outside the bank, where Atlantic water of temperatures up to 5.5° and a salinity of up to 35.00 ‰ had replaced the more diluted Atlantic water which was found in May. The greatest increase in temperature was at a depth of 300 m., and amounted to 3.5° , while the salinity had increased by 0.5 ‰. This phenomenon seems to take place during the summer of each year.

Sections across "Store Hellefiskebanke" (Figs. 25, 26).

The section across "Store Hellefiskebanke" was worked on 10th July and on 13th September. In July the temperature of the water on the bank varied between 2.1° and 3.4° , and the salinity between 33.8 ‰ and 34.0 ‰. In September the temperature had increased by 0.8° — 1.4° and ranged from 2.9° at 100 m. to 4.8° at the surface. The corresponding salinity had decreased by 0.2 ‰ at 100 m. and 0.9 ‰ at the surface and ranged from 33.0 ‰ to 33.8 ‰. In the deeper layers on the western slope of the bank the change in temperature and salinity was only slight.

The section across "Store Hellefiskebanke" was previously worked in July 1928 and 1946. The temperatures observed in July 1948 were generally slightly below those of July 1928 and 1946, but the difference is not very conspicuous. The same is true of the temperatures of the September section compared with the temperatures of the sections worked in the later part of August in the years 1936, 1946 and 1947.

Helge Thomsen.

Hydrographical Investigations in Baffin Bay.

In cooperation with the Royal Danish Hydrographic Office two hydrographical sections were worked between Greenland and Baffin Land from the survey ship "Heimdal", under the command of Captain Axel Schmidt, R.D.N.

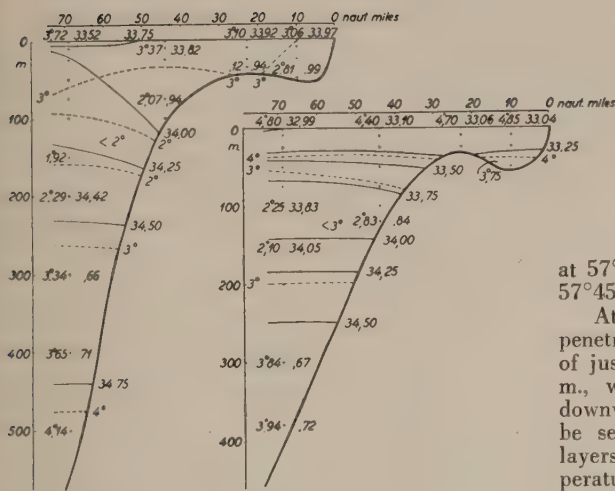


Fig. 25.

Fig. 26.

The northernmost of these sections (Figure 27) followed the $68^{\circ}45'N.$ parallel and was worked from 30th August to 2nd September. The southernmost section (Figure 28) followed the $68^{\circ}15'N.$ parallel and was worked on 2nd and 3rd September.

Both of these sections exhibited the same main features: in the western part of the sections the Baffin Land Current carried cold water southwards, and at the eastern end the West Greenland Current carried comparatively warm water northwards. Again at the western end of the sections, a water layer of negative temperature extended from a depth of about 25 m. to about 300 m. with minimum temperatures of nearly -1.7° . Towards the east the thickness of the layer diminished until it disappeared

Fig. 25. Section across Store Hellefiskebanke, July 10th 1948.

Fig. 26. Section across Store Hellefiskebanke, September 13th 1948.

at $57^{\circ}30' Long. W.$ in the northern section, and at $57^{\circ}45' Long. W.$ in the southern section.

At the eastern end of the sections warm water is penetrating northwards. The core had a temperature of just above 3° , and was found at a depth of 300 m., where the continental shelf begins to slope downwards. The influence of this warm water can be seen not only in the more superficial water layers in the eastern part of the sections, where temperatures between 3° and 1° were predominant, but also in the western part where a layer of positive temperature existed between the cold water of the Baffin Land Current and the Baffin Bay bottom water of negative temperature. The latter was unfortunately not reached, because the available water-bottle wire was too short.

From both sections it is seen that the core of this intermediate warm water layer sloped down from a depth of 300 m. in the eastern side of the basin to about 560 m. in the western side, while the temperature gradually diminished from 3° to 1° .

In 1928, from 9th to 14th September, the "Godthaab"¹⁾ worked a section between Greenland and Baffin Land at nearly the same latitude as the

¹⁾ The Godthaab Expedition 1928. E. Riis-Carstensen: The Hydrographic work and material. Meddelelser om Grønland, Bd. 78, Nr. 3. København 1936, p. 75.

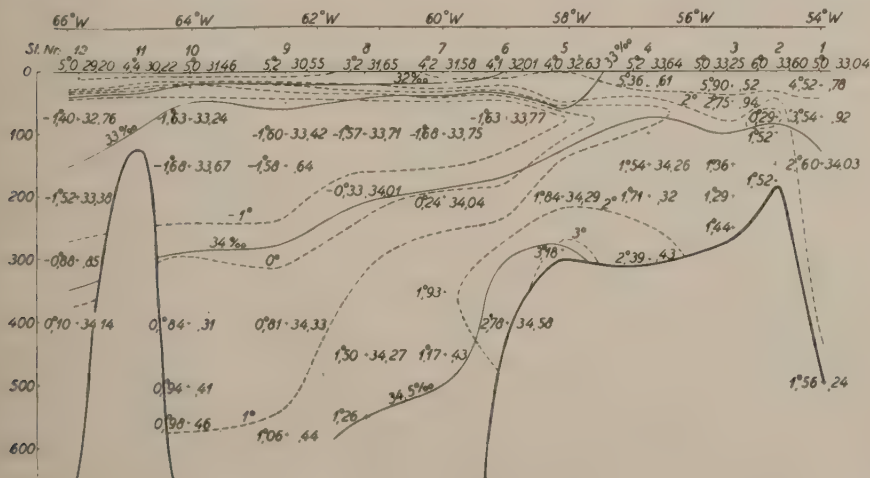


Fig. 27. Section along Lat. $68^{\circ}45'N.$, "Heimdall", August 30th to September 2nd.

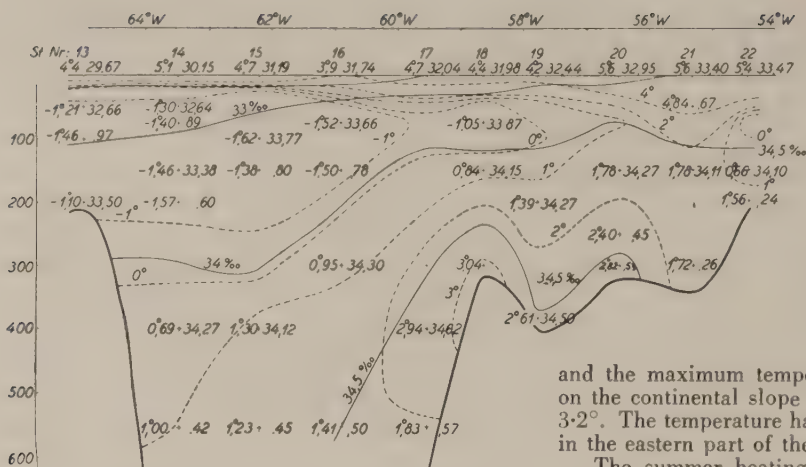


Fig. 28. Section along Lat. 68°15'N., "Heimdal", September 2nd to 3rd 1948.

southernmost of the present sections. The 1928 section and the 1948 sections displayed the same main features, but in 1948 the temperatures generally were higher. The thickness of the water layer of negative temperature at the western end of the section was a 100 m. less, the temperature of the underlying warm water had increased by 0.6° to 1.2°,

and the maximum temperature of the warm water on the continental slope had increased from 2.7° to 3.2°. The temperature had also increased in general in the eastern part of the section.

The summer heating of the surface layer was much more pronounced in the western part of the section in 1948 than in 1928. Thus in 1948 surface temperatures of 4—5° were observed, compared with 1.5°—2° in 1928. In the eastern part of the section the difference was less pronounced, but the 1948 temperatures were still the highest.

Helge Thomsen.

Hydrography in the Neighbourhood of Disko (Greenland) in the summer of 1948, with remarks on the Cod-Fishery.

By

A. Kiilerich.

In connexion with the work of the Greenland Geological Research in North Greenland in the summer of 1948, I had the opportunity of working, from the motor-cutter "K. J. V. Steenstrup", 5 hydrographic sections of the waters at Disko and Nugsuaq (Fig. 1). The instruments were lent to me mainly by the Hydrographic Laboratory, Charlottenlund, and the Navy's Compass Department. Though most of the water samples were titrated during the expedition by the micromethod worked out by A. Lundbæk¹⁾, a more exact titration was carried out on all samples by the Hydrographic Laboratory after our return. The figures will be published in the *Bulletin Hydrographique* 1948.

In the Figures 2—6 the sections are given with isotherms and isohalines, and all present a typical picture of the water's stratification in the arctic regions where during the summer the cold, winter-cooled water layer is heated through the surface and from the warm undercurrent.

In Section I the cold water is a direct continuation of Baffin Bay's cold layer and shows a negative temperature even over the banks, probably right up to the coast of Hare Island. From the dynamic section, Fig. 8, it appears that this cold water forms an eddy at the border of Baffin Bay where the water flows to the north at stations 20 and 21 but to the south over the banks at stations 22 and 23. The warm current is a last offshoot of the Irminger Current and flows north along West Greenland at some depth, finally fading out at the entrance to Lancaster Sound. It shows itself clearly here with a temperature of more than 3° and 34.65 ‰ salinity at a depth of 250—400 m.

Sections II and III which cover the northern approaches to the Vaigat, and Section IV across the southern approach, show some more advanced warming of the cold water layer, especially from below, and the salinity has also increased a little. But both the temperature and the salinity of the warm undercurrent are lower here than outside Hare Island. From the dynamic section it appears that the upper

¹⁾ Kemisk Maanedstidende 1943, No. 8, Copenhagen.

water layers are in movement from south to north through the Vaigat, while those through Maligat, between Disko and Hare Island flow from the west in the direction of the Vaigat as a link in a cyclonic movement around Hare Island. This is also in close accordance with direct observations on the spot: the drift of the ice-bergs through the Vaigat and the movement of the muddy river water towards the east along the north coast of Disko.

The warm undercurrent comes, as seen very clearly in the hydrographic sections, from the north from Baffin Bay round the north of Hare Island to Umanaq Fjord and Vaigat. The two sections across the Vaigat were worked with an interval of only 1–2 days; but while the deep-lying isosteric surfaces lie fairly horizontal (i.e. the water is still) in the southern section, these surfaces slope very considerably in the northern section (the water is in motion, at right angles to the section). At the same time the temperature is more than 1° higher and the salinity about 0.20‰ higher to the north than to the south. A dynamic calculation of the currents in these sections could not, unfortunately, be carried out with sufficient accuracy, but when there is movement in the warm water to the north and not to the south, and it is also warmer and more saline to the

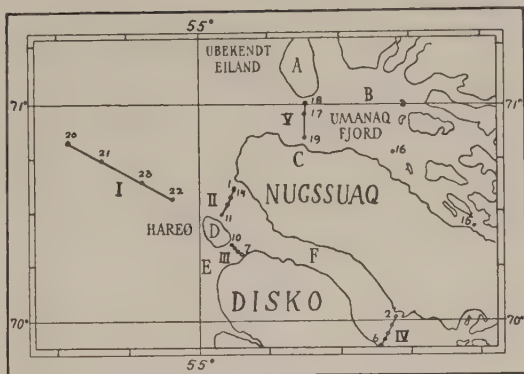
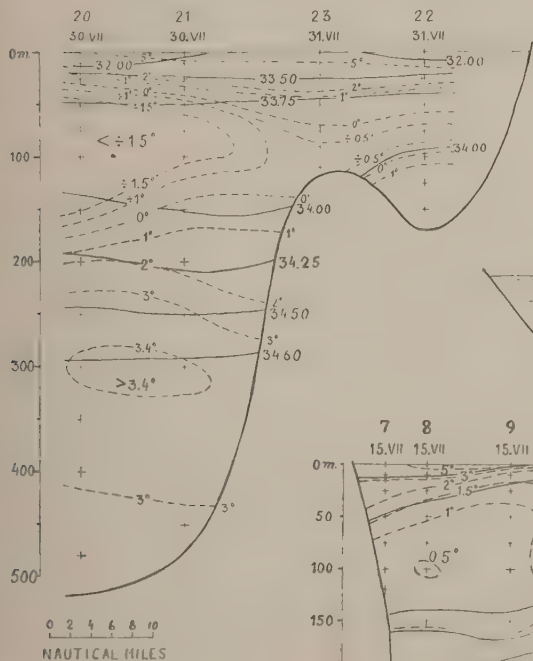


Fig. 1. Position of the hydrographic sections taken from "K. J. V. Steenstrup" in the summer of 1948.

- | | |
|---------------------|------------------|
| A, Ubekendt Eiland. | B, Umanaq Fjord. |
| C, Niaqornat. | D, Hareø. |
| E, Maligat. | F, Vaigat. |

north there can be no doubt that the year's new influx of warm water enters here and only later penetrates southwards through the Vaigat. On the TS-diagram Fig. 7 one can even follow the current with its most strongly pronounced Atlantic character NW. of Hare Island, less strongly pronounced at the mouth of Umanaq Fjord and southwards through the Vaigat. Station 1 and station 14 in Section II are taken at about the same place but with an interval of 4 days, and in the 4 days there occurred a considerable rise both in temperature and salinity from about 100 m. depth downwards. That must



mean, as mentioned above, that it is precisely during these days that the Atlantic undercurrent is flowing forward from Baffin Bay to the northern entrance of the Vaigat; and Section V which is worked at the mouth of Umanaq Fjord 10 days later, shows the same values for temperature and salinity at about the same depth.

Had there been an opportunity of reworking the sections in the Vaigat 2—3 weeks later, we should undoubtedly have met the warm current making good progress. Unfortunately this was not possible; but perhaps the observations mentioned below regarding the fishing are of significance in this connexion.

As far as I know it is not certain that there is any connexion between the cod fishing and the presence of the warm undercurrent. But it is remarkable that the Norwegian fishermen had a particularly good catch west of Disko at the end of July, while there was as yet no catch in the Vaigat. On the 20th July the first cod were caught outside Niaqornat at the mouth of Umanaq Fjord. At Marrait, at the western corner of Nugssuaq, single cod were caught in August, but very great numbers appeared here — even at the surface — about the 8th—10th September. At Qutdligssat, about the middle of the Vaigat, a few cod were caught in the

first half of August, there were more in September and large quantities were found after some heavy gales on the 16th—19th September; according to the District Officer, Fr. Lynge it was, however, too late in the year for the fishing to be of any great importance. Fr. Lynge said besides that the cod can normally be caught on the bank immediately outside Qutdligssat throughout the whole winter if one can get through the ice. In April when the ice is easier to break some cod (and halibut) are always caught, but after that there are none for 2—3 months. It thus appears as though the warm water which at the end of the summer reaches forward to the Vaigat can persist here throughout the winter and not until the beginning of next summer is it replaced by water which does not suit cod.

Reports about the fishing at Sarqaq, at the southern entrance to the Vaigat, agree well with the times for fishing at the northern places; fishing here had been in vain throughout the summer but from the 4th September the cod came in quantity. At Ritenbenk, too, the same fluctuation in the fishing was found in the summer of 1948, only a small amount of cod in August but plentiful from the first half of September.

In the southern part of Disko Bay, on the other hand, the fishing follows another rhythm. At Christ-

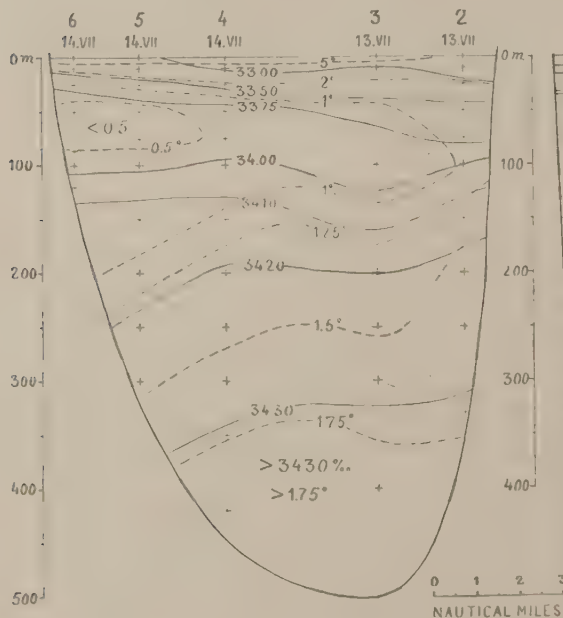


Fig. 5. Section IV. Across the southern part of the Vaigat.

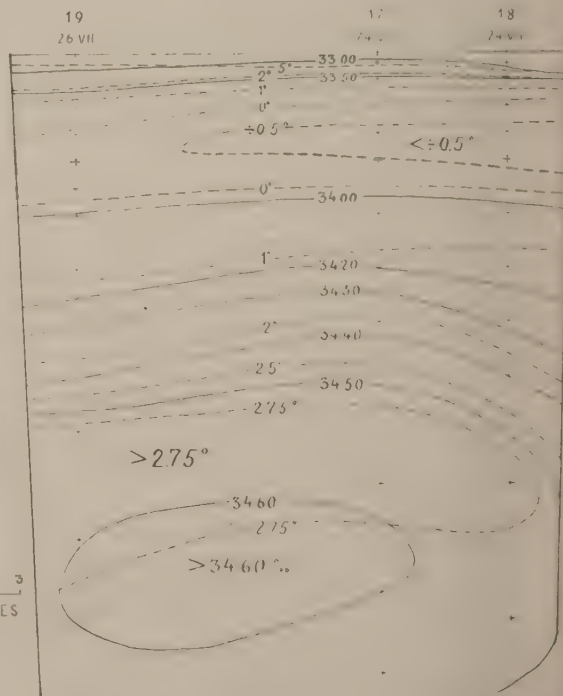


Fig. 6. Section V. Across the mouth of Umanaq Fjord from Ubekendt Eiland to Niaqornat.

ianshaab for example cod fishing normally begins on the 10th—12th July — though in 1948 it did not start until the middle of August — and stops very early and completely immediately the summer is over. It is the same at Jakobshavn and several other places in this district.

If there is a connexion between the warm undercurrent and the fishing it thus looks as if the warm water, which in the course of the early summer leaves the districts W. and SW. of St. Hellefiskebanke to flow further north, immediately sends a lesser offshoot in along the south coast of Disko Bay — perhaps at a relatively slight depth — while the main current runs outside Disko and only reaches the northern opening of the Vaigat in the last half of summer. From this opening there is a deep approach to Disko Bay while the entrance to it directly from the SW. is narrow and irregular as far as the greater depth is concerned. But, as I have stated in an earlier paper¹⁾, there is much which suggests that the warm undercurrent which in summer reaches forward to the waters round Disko or further to the north is of Atlantic origin, but it has come to the districts off West Greenland already in the course of the previous summer and autumn and so has lain still at a depth of 5—700 m. south of the ridge between Greenland and Canada throughout the spring and early summer until the currents are intensified in the summer and lead it further north. It is therefore probable that

¹⁾ Medd, fra Komm. for Danmarks Fiskeri- og Havundersøgelser. Serie: Hydrografi. Bd. III, Nr. 3. 1943.

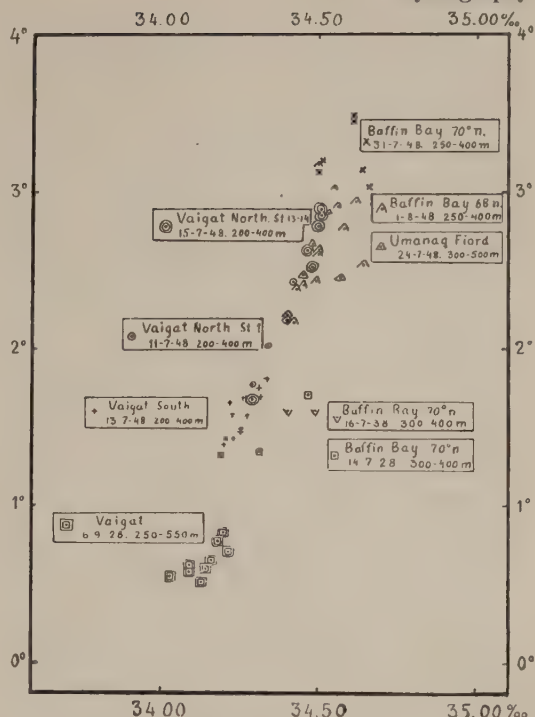


Fig. 7. TS-Diagram of observations in the warm undercurrent 1948, 1938 and 1928.

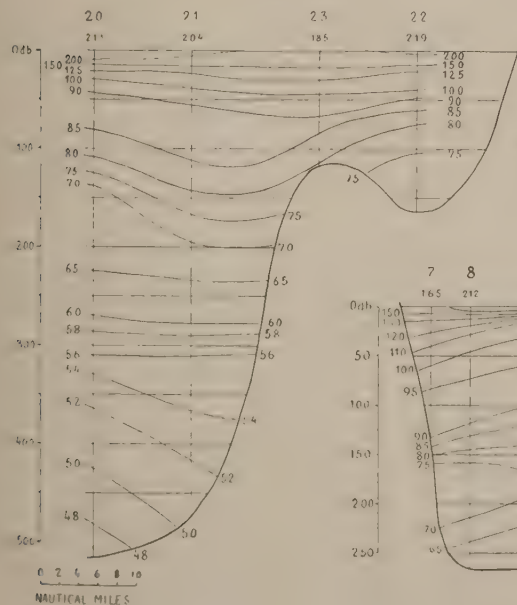


Fig. 8. Section I.
Solenoidal Field.

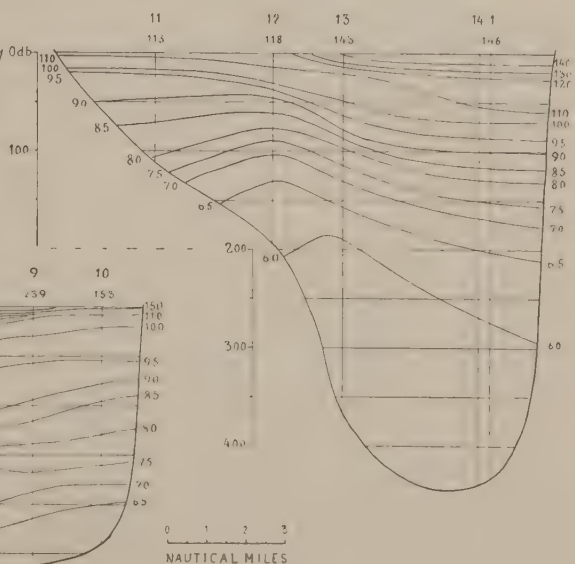


Fig. 10. Section III.
Solenoidal Field.

Fig. 9. Section II.
Solenoidal Field.

possible fluctuations in the character of the warm water do not take place at the same time off the southern and northern parts of Greenland but have, rather, been delayed a year.

Whether this account of the way the warm under-current comes to the Vaigat and Disko Bay only applies to 1948 or whether it usually acts like this cannot be determined from the material so far collected; but it is a question of importance for the commercial fishery.

The TS-diagram Figure 7 shows the character of the warm water masses in the section dealt with in 1948 and some sections from previous years. As far as 1948 is concerned it is immediately obvious that Baffin Bay's warm water has the highest temperature and salinity while these values decrease south through the Vaigat. Further, one at once notices the significant change which occurs in the course of the days 11th to 15th July between station 1 and stations 13—14. Besides these observations from "K. J. V. Steenstrup" there are also marked on the diagram observations on the warm current in the two sections which were laid from H. M. S. "Hejmdal" across the southern part of Baffin Bay on about 68° Lat. about the 1st September 1948. But the temperature and salinity are here found not quite as high as in "Steenstrup's" sections which possibly can be taken to support the opinion that this year's new flow of warm water has not yet

come to these parts, but that it is still only water which flowed forward along South Greenland's west coast from last autumn until sometime during the winter.

Not a great deal of earlier observation material is found from these districts. There is most from the "Godthaab Expedition" 1928, which, in the middle of July, laid a section from Disko to the west, and in the beginning of September 3 sections across the Vaigat. In the section outside Baffin Bay only 2 observations are found within the warm current, but they both show 1.5—2.0° colder water than in 1948, and in the Vaigat the warm water only rises to 0.6—0.8°, while in 1948 it was 1.4—1.8° to the south and 2.5—2.9° to the north. Two observations by the French ship "Ville d'Ys" from Baffin Bay in 1938 agree exactly with "Godthaab's".

1928 was the first year which clearly showed the present warm period and everywhere all over the West Greenland waters the temperature was considerably higher than what had hitherto been reckoned as normal. In the 20 years which have elapsed since 1928 the temperature has risen further, and to-day observations from 1928 seem to us just as cold as observations from the beginning of the century seemed to us in 1928. The south-eastern part of Baffin Bay and the bordering fjord districts have, in the course of the last 20 years, lost their pronounced arctic character and have ended by now

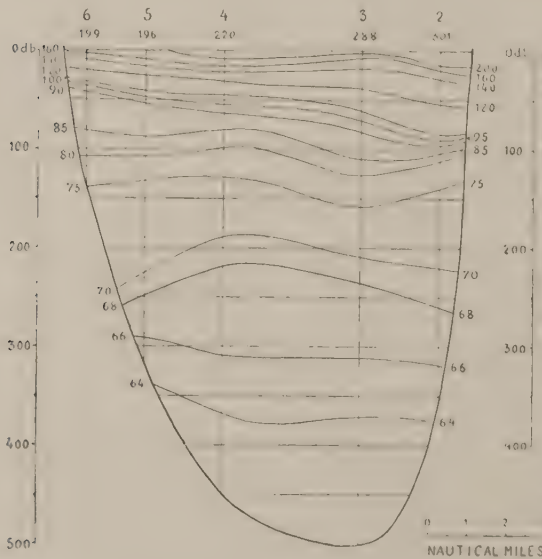


Fig. 11. Section IV. Solenoidal Field.

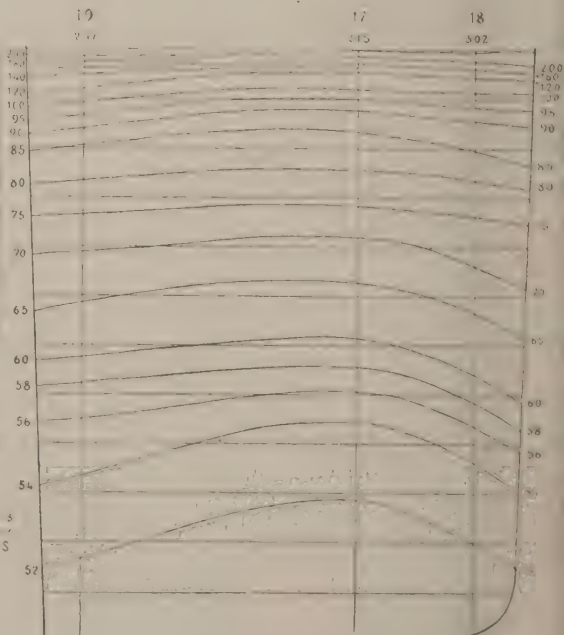


Fig. 12. Section V. Solenoidal Field.

looking hydrographically more like the districts off South Greenland.

From a number of the intervening years there exist some short sections at the fishing banks off South Greenland taken by the Danish Navy at the request of the Hydrographic Laboratory. The years 1934, 1936, 1937, 1946, 1947, and 1948 all show warm water and do not differ much from each other; 1934 is perhaps the warmest, closely followed by 1948. Corresponding observation material is found from 1938 but it shows a considerably colder summer.

While in the arctic regions east of Greenland there are signs that the summer of 1948 was colder than usual for the last years, this does not appear to have been the case in the regions examined off West Greenland. But, as suggested above, a possible drop in temperature may appear in Baffin Bay delayed for one year or more as compared to South and East Greenland.

In the Figures 8—12 the sections are given as solenoidal fields so one can carry out all the dynamic calculations one wants. The curves show the anomaly in the specific volume calculated according to H. U. Sverdrup's tables¹⁾.

I have not, on the other hand, found it expedient to construct sections showing the calculated speed of the current or the transport of water through the section, as it is impossible to estimate with fair accuracy in what depth the reference surface ought to be laid.

It is probably best to work with Section I where both the cold and the warm water may be taken as flowing north. If the warm undercurrent moves north, the reference surface must be laid beneath it, and if one lays it thus at 460 db pressure the core of the warm current at a depth of about 300 m. between stations 20 and 21 has a speed at right

angles to the section of 1 cm./sec. ($\frac{1}{2}$ mile in 24 hours), while the surface water flows at 5.5 cm./sec. The collected transport of water through the section between stations 20 and 22, taking 460 db and the bottom (where it is higher than 460 m.) as reference surface is 1.16 km³. an hour of which 0.33 km³. per hour consists of the warm water at 200 m. depth downwards.

In the Vaigat the reference surface must necessarily be laid over the warm water if one accepts the theory that it flows south. The influx of warm water to station 14 reaches up to between 100 and 150 m. depth so that it would not be unreasonable to lay the reference surface so high in this part of the section; but whether in the rest of the section it should be laid at a lesser or greater depth we have not any means of estimating, so that it would be pointless to carry out anything other than the most simple calculations. In the field between station 13 and 14 there is a difference of speed of 22 cm./sec. between the surface water and the layer at 360 db and if we arbitrarily lay a horizontal 0-surface at a depth of 140 m. the surface water flows north with a speed of 14 cm./sec. while the warm water at a depth of 300—360 m. will flow south at 8 cm./sec (3.7 miles in 24 hours).

Section III across Maligat, with reference surface at a similar depth, will have a current in the upper water layer from the west in towards the Vaigat and at the bottom a current of warmer water out towards Baffin Bay. The southern Vaigat section will, in the same way, have a north-flowing current in the upper water layers while there is not much movement in the deeper. At the mouth of Umanaq Fjord there is a faint cyclonic movement with inward flowing current along the coast of Nugssuaq and outward flowing along Ubekendt Eiland over the reference surface and in the opposite direction beneath it; but we have no possibility of judging how deep it should lie.

¹⁾ Geofysiske Publ. Vol. X, Nr. 1. Bergen 1933.

Plankton.

Macroplankton in the Faroe Channel, 1948.

Plankton investigations were made in the Faroe Channel in 1948 by the Scottish research vessel "Explorer" in May and July, and by the "Scotia" in December.

The nets used for collection of macroplankton samples were one metre in diameter and made of stramin; they were towed at the surface, 50 metres, 100 metres or 250 metres depth. The station positions are indicated on the attached chart.

In May, *Calanus finmarchicus* was more abundant on the Faroe side of the traverses, and *Anomalocera* on the Scottish side. *Calanus hyperboreus*, *Metridia longa*, *Pleuromamma robusta*, *Euchirella rostrata* were found on the northerly traverse, chiefly east of 4°30'W., and at these stations *Meganycitaphanes*

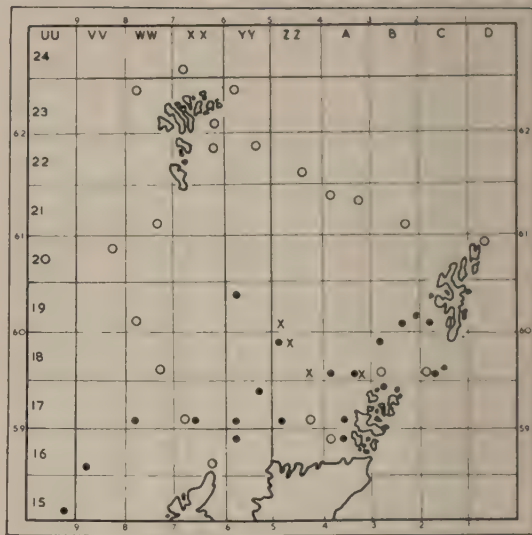
norvegica, *Eukrohnia hamata* and *Sagitta elegans arctica* were also found. *Thysanoessa longicaudata* was found at most of the stations in the Channel and also to the east of Faroe. *S. elegans elegans* was almost entirely absent in the Channel and very much scarcer in Faroese waters than in June 1947. Macroplankton between Faroe and the Butt of Lewis was very scarce in May though some *Eukrohnia hamata*, *S. serratodentata*, *Galettia australis* and *Aglantha* were found at the southern end, with *Meganycitaphanes*, *Eurydice grimaldii* and *Tomopteris*. Plance eggs were taken from the north and east of Faroe, and very abundant larvae of Hyas were found north-west of Faroe. *Galettia australis*, *Laodicea*, *Sarsia*, ephyrae of *Aurelia*, and *Oikopleura vanhoffeni* were also present near Faroe.

The July investigations in the Channel were less extensive, but by then the fauna had increased very considerably. *Calanus* was still not plentiful but many oceanic species were taken, including *Dimophyes arctica*, *Galettia australis*, *Lensia conoidea*, *Chelophyes appendiculata*, *Agalmopsis elegans*, *Halopsis ocellata*, *Laodicea undulata*, *Cosmetira* sp. (? *pilosella*), *Aglantha digitalis* (very abundant), *Sagitta lyra*, *S. serratodentata*, *Eukrohnia hamata*, *Clio pyramidata*, *Diacria trispinosa*, *Rhincalanus nasutus*, *Eucalanus elongatus*, *Meganctiphanes norvegica*, and larvae of *Sergestes arcticus*, *Discias atlanticus*, scopelid fish and *Fierasfer*.

A still smaller excursion to the north-west of Orkney was made in December and this showed that the oceanic fauna still existed there. It included patches of abundant *Meganctiphanes norvegica* and *Anchialus agilis*, with *Euphausia krohnii*, *Thysanoessa longicaudata*, *Nyctiphanes couchii*, *Prinno macropus*, *Sagitta lyra*, *S. hexaptera*, *S. serratodentata*, *Lensia conoidea* and *Chelophyes appendiculata*.

Details of the plankton in the neighbouring areas may be found in the Northern North Sea report.

J. H. Fraser. A. Saville.



Position of plankton stations investigated by the Scottish research vessels in 1948:

○ = May, ● = July, × = December.

THE FISH.

Eggs and Larvae.

Occurrence of 0-group Cod, Haddock and Coalfish. Summer 1948.

In the middle of June 1948 the "Dana" made a survey of the pelagic stages of cod, haddock, and coalfish, in the Faroe area (Table 1 and Fig. 1). With a few exceptions two 30-minute oblique hauls with 2 m. stramin nets with 100—25 and 200—125 m. of wire streamed respectively were carried out on each of the 19 stations where the depths were between 50 and 200 m.

The average lengths of the cod and haddock larvae were 20.0 and 14.8 mm. respectively, which is higher than previously found in June in this area (average of all previous samples: 13.6 and 11.8 mm.), and corresponds to the lengths which should normally be found in the first half of July. The number of specimens per haul must therefore be compared with those previously found in the beginning of July. Thus very few coalfish remained in the plankton (0.8 per 1-hour haul); and the number of cod (52.3 per 1-hour haul) indicates that larvae of this species were more numerous in

Faroe.

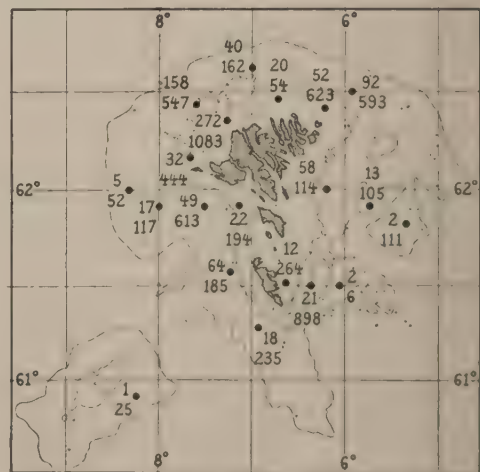


Fig. 1. Larval stages of cod (upper figures) and haddock (lower figures). Number of specimens per ½ hour haul with 2 m. stramin net. 13th—24th June 1948.

Table 1. Larval Cod, Haddock and Coalfish.Total catch at 19 stations¹⁾ over depths between 50 and 200 m. 13–24 June 1948. (Positions in Fig. 1.).

Length in cm.	0.5-0.9	1.0-1.4	1.5-1.9	2.0-2.4	2.5-2.9	3.0-3.4	3.5-3.9	Total No.	No. per hour	Av. length in mm.
Cod	10	117	291	360	117	18	3	916	52.3	19.99
Haddock	568	1998	1293	421	115	25	8	6250 ²⁾	357.0	14.76
Coalfish	—	—	2	8	4	—	—	14	0.8	23.40

¹⁾ At all but three stations, oblique hauls with two 2-m. stramin nets were made, one being towed for 10 minutes at each of the depths corresponding to 100, 50, and 25 metres of wire streamed respectively, and the other for the same time at depths corresponding to 200, 150, and 125 metres of wire. At the three remaining stations, one haul only was made, with 100, 50, and 25 metres of wire streamed.

²⁾ Including 1822 specimens not measured.

1948 than normally, but not nearly as abundant as in 1947 (cf. Ann. Biol. Vol. IV p. 29). The number of pelagic haddock larvae (357 per 1-hour haul) indicates that the 0-group of 1948 was nearly as abundant as that of 1947 which was more numerous than any previously observed in this area.

From the 7th—11th of August 16 hauls with the eel hand-seine were carried out in four localities in the fjords. The catch of 0-group cod did not confirm that this year-class was especially abundant. Even when a displacement of the season was allowed for, the average number (9.3 per haul) was slightly below the usual figure. On the other hand the average number of 1-group cod (7.0 per haul) was found to be above the normal, agreeing with the observation that this year-class was very numerous as pelagic larvae in 1947. The average number of 0-group coalfish (387 per haul) was somewhat above the normal, but the average number of 1-group specimens (2.7 per haul) was below, although, as the 0-group, this year-class was found to be very numerous in the littoral zone in 1947.

The disagreement between the results obtained from collections of pelagic and of littoral stages is suspected as being due mainly to the fact that a very large number of hauls with the eel hand-seine is necessary to obtain an adequate measure of the abundance of the littoral stages in the Faroe fjords.

E. Bertelsen.

Lemon Soles.

The Scottish trawl fishery at Faroe during 1948 was characterised by greater fluctuations than in recent years. During the first four months, good fishing was experienced and the number of trawler trips was somewhat higher than in 1947. Towards the end of April, however, all species of fish became scarce, with the result that during the month of May, not a single complete trawl catch was landed at Aberdeen from Faroese grounds as compared with 39 landings in the same month of 1947. Several vessels tried unsuccessfully to locate fish shoals in the area but all were compelled to shift either to home waters or to Iceland in order to obtain a suitable catch for the market. At the beginning of June, with the advent of daylight fishing, good results

were obtained and a considerably larger number of trips were recorded during this month than in June of 1947. This satisfactory fishing continued throughout July and August when the number of trips equalled those of the previous year. As usual in this area the appearance of vast shoals of jellyfish on the grounds hastened the end of the summer daylight fishing at the end of August, but on this occasion a marked scarcity of all species of fish also contributed to the poverty of results. During September, only 8 complete trips were made to Faroe from Aberdeen as against 41 in the same month of 1947. This scarcity of fish at Faroe continued throughout October and November and into December when signs of improvement began to appear before the end of the year.

Although the annual average catch per 100 hours fishing by Aberdeen trawlers at Faroe of each of the three chief species, cod, haddock and lemon sole, has shown a steady decline since the end of the war, these averages and the total quantities of each species are still higher than the corresponding figures for pre-war years. In these circumstances no immediate explanation can be given of the collapse of the fishery during the last four months of 1948.

The "Explorer" visited Faroe from 4th—8th May but only 16 lemon soles were caught in seven trawl hauls. This is considerably below the average number of this species taken by the Scottish research vessel on previous visits and consequently scale and measurement sampling of the Faroese stocks on this occasion has been entirely from commercial catches landed at Aberdeen.

Twenty-eight catches were sampled between 29th I and 29th XII comprising 2732 lemon soles. The size composition of the fish, in 5 cm. groups with per mille figures, is given in Table 2, which also includes the corresponding per mille figures for 1947.

This shows that a slightly smaller proportion of very small fish (i.e., less than 26 cm.) was landed in 1948, due possibly to the enforcement of the minimum size regulations of 10 inches (25.4 cm.). An appreciable increase in the proportion of fish in the 26—30 cm. group occurred in 1948 and was accompanied by a slight decrease in the proportions of the larger size-groups.

The age composition of these samples is present-

Table 2.

Size-Group cm.	No.	1948 ‰	1947 ‰
<26	125	46	51
26—30	790	289	238
31—35	1167	427	434
36—40	546	200	233
41—45	99	36	44
46—50	5	2	+

ted in Table 3, in comparison with those for 1945—1947, and the corresponding estimates of the catches per 100 hours fishing with their per mille composition.

During 1948 the outstanding brood numerically was that of 1943 which first began to appear in the catches in large numbers in the latter half of 1947.

Although now numerically inferior to 1943 the broods of 1941 and 1939 also contributed appreciably to the lemon sole catches during 1948. Those of 1936 and 1937, which supplied the bulk of the catches in the months immediately following the end of the war, have now been much reduced although they continued to outnumber other older year-classes.

The catch of all lemon soles per 100 hours fishing has fallen from 2364 fish in 1947 to 1832 fish in 1948 — a 23 % reduction. This reduction has naturally been very marked in age-groups of 7 years

and over — the amount varying from 39 to 60 %. These results show that the age composition of the Faroe lemon sole stock continues to become younger and it is clear that this feature would be more marked if it were not for the succession of good broods in alternate years 1941—1939—1937 and also 1936, which have maintained the stocks of large and old fish.

Bennet B. Rae.

Iceland.

Cod.

Age Distribution.

Fig. 2 shows the age distribution of long-line caught cod from the spawning grounds off the south and south-west coasts during the years 1945—1949. The 1936 year-class is shown black.

From the figure we clearly see how this year-class has dominated in the catches to a progressively greater extent since 1946. It does not appear as though much of importance will originate from the 1937, 1938 or 1939 year-classes, since, for the most part, they are already mature.

Marking Experiments.

In 1948 some 1175 cod were marked in 7 different localities in Icelandic waters. These are the first marking experiments on cod since 1939 and the beginning of a large marking programme.

Table 3. Lemon Soles, Faroe.

Table showing (a) Age composition of the samples, (b) The corresponding catch per 100 hours fishing, and (c) The corresponding per mille composition, for years 1945—48.

Brood	Year 1945			Year 1946			Year 1947			Year 1948		
	A	B	C ‰	A	B	C ‰	A	B	C ‰	A	B	C ‰
1946	—	—	—	—	—	—	—	—	—	6	2	1
1945	—	—	—	—	—	—	—	—	—	32	27	15
1944	—	—	—	—	—	—	21	15	6	201	163	89
1943	—	—	—	31	52	20	357	426	180	889	557	304
1942	—	—	—	22	47	18	140	139	59	191	139	76
1941	5	83	46	158	466	176	503	457	193	456	276	151
1940	4	55	30	32	95	36	120	133	56	105	71	37
1939	19	234	129	165	520	196	482	426	180	383	266	145
1938	7	100	55	49	169	64	144	158	67	89	64	35
1937	31	451	248	146	550	208	344	368	156	209	148	81
1936	27	362	199	82	392	148	163	152	64	119	87	47
1935	22	290	159	42	190	72	56	48	20	22	14	8
1934	10	127	70	24	98	37	44	30	13	12	8	4
1933	4	33	18	7	40	15	6	5	2	6	2	1
1932	5	66	36	2	10	4	5	3	1	5	7	4
1931	1	5	3	3	12	5	5	2	0.8	1	1	0.5
1930	1	14	8	—	—	—	1	1	0.4	—	—	—
1929	—	—	—	—	—	—	1	1	0.4	—	—	—
1928	—	—	—	—	—	—	—	—	—	—	—	—
1927	—	—	—	1	8	3	—	—	—	—	—	—
Total	136	1820		764	2649		2392	2364		2726	1832	

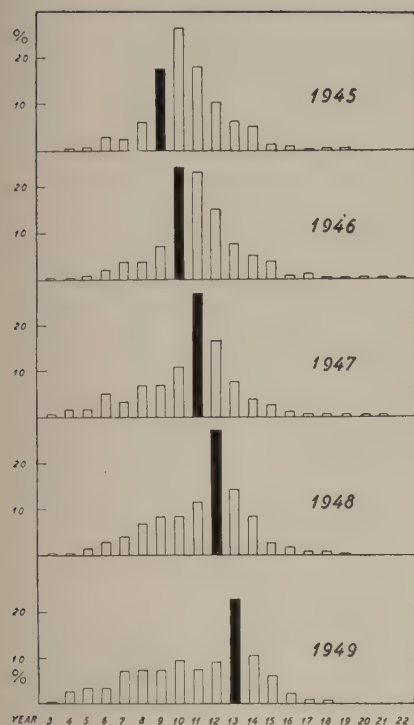


Fig. 3. Cod marked in Skagafjörður 28/5 48. Chart showing the places of recaptures together with the number of days in freedom.

Fig. 2. The age distribution of the Icelandic Stock of Cod during the years 1945—1949. Long-line catches from the spawning areas off south and south-west Iceland.

Marking took place from 15. May to 18. June. In Skagafjörður on the north coast (position $66^{\circ}00'N.$, $19^{\circ}48'W.$) 691 cod were marked on 28. May 1948. The chart, Fig. 3, shows the positions of recaptures together with the number of days in freedom.

Of the fish marked in Skagafjörður about 90 % were immature, the average length was 62 cm. and the age distribution as follows:—

Age in years	3	4	5	6	7	8	9
%	3.6	42.6	28.4	15.2	7.1	2.1	1.0

During the first 12 months about 7 % of the marks have been sent in. 80 % of these have been recaptured off the north coast and 20 % on the spawning grounds on the south and west coasts.

Jón Jónsson.

Lemon Soles - Iceland.

Eight samples of lemon soles from Icelandic grounds were obtained from Aberdeen and Faroese trawlers between 19th May and 10th June, 1948 and two more were obtained from Icelandic seine-netters

in September. With one exception all the catches were from southern Icelandic grounds and most of the lemon soles were procured in the vicinity of the Westmann Isles. The size composition of these samples totalling 794 fish, is as follows:—

Table 4.

Size-Group cm.	No.	0/00	Size-Group cm.	No.	0/00
<26	15	19	36—40	294	370
26—30	118	148	41—45	72	91
31—35	292	368	46—50	3	4

About 74 % of the fish measured between 31 and 40 cm. length, thus differing from landings from Faroe, of which 67 % lay between 26 and 35 cm. The age analysis of the Icelandic lemon soles is given in Table 5 (see p. 34).

The most remarkable feature of this analysis is the complete absence of 2-, 3- and 4-year-old fish which seldom fail to be represented in lemon sole catches elsewhere. Moreover, the capture of only two 5-year-old fish of the 1943 brood, which has proved so successful at Faroe, and of only fifteen 6-year-old fish shows that the stock on the southern Icelandic grounds in 1948 was largely composed of

Table 5.

Broods	No.	‰	Broods	No.	‰
1943	2	2	1935	27	34
1942	15	19	1934	14	18
1941	205	259	1933	6	8
1940	134	169	1932	3	4
1939	227	287	1931	4	5
1938	63	79	1930	3	4
1937	37	47	—	—	—
1936	51	64	1926	1	1

old fish. The most prolific broods were those of 1939 and 1941 while fish of 10 years of age and over made up 26 ‰ of the catch as against 17 ‰ by the same broods at Faroe.

Bennet B. Rae.

Cod.

West Greenland.

Age and Length.

In the years 1940—1948 the collection of otoliths of cod for age determination was continued at several fisheries stations in West Greenland. A total of 18,611 otoliths were examined.

The results are given in the accompanying tables. The material is divided into two groups corresponding to different areas. The northern districts cover the districts north of 62°30' N. Latitude, and the southern districts extend from this latitude to the southern point of Greenland.

The three rich year-classes 1922, 1924, and 1926, which were dominant for many years, had nearly disappeared by 1940, with the exception of the 1926 year-class which in 1940 and 1941 amounted to 10·7

and 19·5 ‰ respectively in the northern districts. In the southern districts the 1926 year-class amounted to 7·2 and 10·1 ‰ in the same two years. In 1942 and the following years it was of negligible importance.

The two year-classes 1931 and 1932, which were of some importance in the years 1935—1939, were only slightly represented in the period 1940—48, especially in the southern districts, where the percentages of these two year-classes were below ten throughout the nine years. In the northern districts will be noted the unusual phenomenon that the 1931 year-class amounted to 14·4 and 16·8 ‰ in 1941 and 1943 respectively, and the 1932 year-class to 15·8 ‰ in 1946, while these two year-classes in other years never comprised more than 10 ‰ of the catches.

The relative importance of the various year-classes in the catches can be seen from Table A. *The 1934 year-class has been the richest which has appeared in the Greenland cod stock* and has been of the greatest importance for the fishery based on the Greenland population. The yield of this year-class, in the eleven years in which it has occurred in the catches, has amounted to more than twenty thousand tons.

The average lengths in 1948 of different age-groups of cod in the various districts are given in Table B (see p. 36).

It is seen that the mean length of a given age-group is similar in the different districts, except in Godthaabsfjord where it is much lower than in other localities in Greenland.

If we compare the mean lengths of 1948 given in Table B with the mean lengths of correspond-

A. Age Composition in Percentages

1. Northern Districts.

Year:	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
No. analysed:	505	205	304	719	1221	2849	456	2834	1992	11,085
Age-Group										Brood of
IV	—	—	—	0·3	0·9	0·9	10·3	0·2	0·5	
V	9·1	2·4	1·6	0·1	6·2	2·7	8·8	4·8	3·0	
VI	31·3	2·4	25·7	1·5	5·3	6·0	4·6	4·1	19·4	1942
VII	6·7	8·8	9·5	9·2	4·6	1·9	3·5	5·3	6·9	
VIII	9·3	1·5	14·1	5·3	18·8	2·8	3·3	6·1	4·8	
IX	8·9	5·4	3·3	33·2	8·5	26·4	2·6	2·6	4·8	
X	2·4	14·4	8·2	6·5	30·1	8·6	14·9	4·1	1·8	
XI	5·3	2·9	8·9	8·9	4·5	32·1	3·9	17·5	2·1	
XII	4·0	10·7	1·6	16·8	6·6	5·0	24·8	12·5	21·3	1936
XIII	5·0	15·1	9·2	2·2	6·5	7·2	2·2	29·6	3·7	
XIV	10·7	6·8	5·9	5·3	1·6	3·2	15·8	4·2	24·7	1934
XV	0·8	19·5	4·6	2·6	1·5	1·2	0·7	4·1	1·1	
XVI	4·6	2·9	6·6	1·4	1·4	0·7	0·9	2·7	3·6	
XVII	—	5·9	—	5·3	1·2	0·3	0·9	1·1	1·5	
XVIII	1·4	—	0·3	0·1	1·4	0·5	0·7	0·4	0·3	
XIX	—	1·5	—	0·4	—	0·4	0·7	0·1	0·1	
XX	—	—	0·3	—	0·4	0·1	1·3	0·1	0·3	
XXI	0·6	—	—	0·4	0·2	0·1	—	0·2	—	
XXII	—	—	—	0·1	0·3	—	0·2	0·1	0·2	1926

ing age-groups during the years 1924—39 given in Table 19, pp. 110/11 in *Ann. Biolog.*, Vol. I, 1943, it is obvious that the 1948 values are lower than those of previous years. It has been shown that this is due to a slower growth of the younger year-classes, e.g., those of 1934 and 1936, compared with older year-classes, e.g., those of 1922, '24, and '26.

Racial Characters.

Vertebrae and fin-rays in D₂ were counted in samples of I-group cod (i.e. year-class 1947) from different localities along the West Greenland coast between about 60° and 70°N. Latitude. The results are given in the table below:—

Locality	Ikerassak	Christianshaab		Ekalugars-suit Julianeh.
		Shallow water	Deep water (about 400m.)	
Position, N.	70°30'	68°50'	68°50'	60°46'
Position, W.	51°05'	51°10'	51°15'	46°09'
No. of Vert.				
52	1	6	2	7
53	45	42	30	38
54	44	49	58	57
55	13	7	20	3
56	1	—	2	—
Total No.	104	104	112	105
Mean	53.69	53.55	53.91	53.53

There seems to be virtually no difference in the mean number of vertebrae even though the samples are from localities a great distance apart.

Paul M. Hansen.

Halibut.

Since the halibut fishery stopped at the end of the thirties owing to the decrease in the stock of this fish which followed the heavy increase in foreign fishing, it has been very difficult to get otolith material to study the age-composition of the stock.

In 1947, however, a Greenland fisheries officer working in connexion with long-line fishery for halibut off the west coast of Disko island at about 69° N. Latitude, furnished us with a sample of 113 halibut otoliths and the corresponding length measurements. The results of the age-analysis, together with the average length of each age-group, are given below.

Year-Class	Age-Gr.	%	Average Length	
			♂	♀
1939	VIII	4.4	—	80.8 (5)
1938	IX	15.9	89.8 (4)	88.9 (14)
1937	X	2.7	—	103.3 (3)
1936	XI	54.9	96.9 (9)	98.3 (53)
1935	XII	1.8	—	115.0 (2)
1934	XIII	14.2	115.0 (1)	114.3 (15)
1933	XIV	0.9	—	131.0 (1)
1932	XV	4.4	—	123.8 (5)
1928	XIX	0.9	—	144.0 (1)

It is seen that the 1936, 1938, and 1934 year-classes are predominant in the catch, and it is of interest to note that the 1936 and 1934 year-classes are also the richest in the stock of cod, although in this fish, the 1938 year-class has been of only slight importance.

Paul M. Hansen.

(III-Gr. omitted) Greenland Cod.

2. Southern Districts.

Year:	1940	1941	1942	1943	1944	1945	1946	1947	1948	Total
No. analysed:	1119	615	198	1550	401	338	949	1549	807	7526
Age-Group										Brood of
IV	6.8	2.0	—	0.3	0.3	—	3.0	0.9	0.4	
V	13.0	14.8	1.0	0.4	0.5	1.8	2.2	5.4	3.5	
VI	26.7	18.7	40.4	2.7	1.7	7.9	1.5	3.2	12.6	1942
VII	11.4	11.4	18.7	30.3	6.0	4.4	6.4	2.6	5.5	
VIII	9.8	4.7	29.3	17.0	34.9	7.1	6.2	5.4	5.8	
IX	6.5	4.9	0.5	17.9	9.5	19.8	6.2	4.3	9.3	
X	2.1	6.7	3.5	4.6	31.2	11.5	29.2	3.9	6.3	
XI	4.0	3.3	1.5	6.1	1.7	25.7	8.7	19.9	3.3	
XII	2.3	6.2	0.5	6.6	5.5	8.6	18.7	9.1	19.1	1936
XIII	4.2	7.0	1.0	2.6	4.7	5.0	2.7	28.4	5.8	
XIV	7.2	5.2	—	4.1	0.3	3.8	8.2	4.8	22.3	1934
XV	1.0	10.1	1.0	1.9	1.7	1.5	1.9	4.9	1.0	
XVI	3.4	0.5	2.0	3.2	0.3	1.8	1.8	4.1	4.0	
XVII	0.3	2.6	—	1.4	0.3	0.6	0.6	1.0	0.6	
XVIII	1.3	0.2	0.5	0.2	0.5	0.3	1.1	0.7	0.2	
XIX	0.1	1.8	—	0.3	—	—	0.3	0.3	—	
XX	—	—	—	0.1	0.5	—	1.3	0.3	0.1	
XXI	—	—	—	0.1	—	—	—	0.4	—	
XXII	—	0.2	—	—	—	—	—	—	0.1	1926

B. Average Lengths of different Age-Groups of Greenland Cod.

Districts:		Jakobs- havn		Egedes- minde		Sukker- toppen		Godthaabs- fjord		Fiske- næsset		Frederiks- haab		Juliane- haab	
Age-Gr. Year-Cl.	Sex	N ¹⁾	M	N	M	N	M	N	M	N	M	N	M	N	M
1944	♂	—	—	3	51.7	—	—	—	—	—	—	—	—	71	42.8
IV	♀	3	54.7	4	47.5	—	—	—	—	—	—	—	—	81	43.2
1943	♂	7	58.0	20	55.4	—	—	2	45.5	—	—	—	—	100	53.9
V	♀	10	62.6	21	54.0	1	60.0	—	—	—	—	—	—	103	53.2
1942	♂	38	65.0	110	63.6	28	64.6	1	52.0	2	75.0	—	—	149	63.5
VI	♀	31	66.3	158	60.1	27	63.0	—	—	2	74.0	—	—	149	63.4
1941	♂	18	69.2	37	69.4	8	69.1	1	58.0	1	73.0	—	—	46	65.9
VII	♀	13	71.2	49	70.1	9	68.6	2	63.5	3	76.3	1	65.0	57	69.2
1940	♂	7	73.7	26	73.9	6	71.2	1	66.0	5	77.6	—	—	29	70.8
VIII	♀	12	73.4	25	75.3	8	73.8	1	68.0	6	79.5	1	65.0	41	73.1
1939	♂	8	76.8	17	74.0	4	71.3	1	64.0	4	77.0	1	75.0	45	74.9
IX	♀	16	79.1	28	77.8	9	72.6	2	67.5	10	82.1	2	75.0	42	76.8
1938	♂	2	78.5	2	77.0	5	73.6	1	70.0	4	77.5	2	77.0	29	75.2
X	♀	3	77.0	9	76.7	5	76.2	4	63.5	6	76.8	—	—	34	79.6
1937	♂	6	75.5	4	79.5	1	69.0	3	67.0	4	81.5	1	80.0	18	76.1
XI	♀	9	78.4	5	82.8	7	81.9	—	—	6	84.7	1	90.0	11	79.0
1936	♂	50	79.0	103	78.1	30	78.0	2	68.0	18	80.3	11	78.2	79	79.3
XII	♀	59	81.5	125	80.5	21	80.3	3	70.0	18	84.3	5	78.8	105	85.0
1935	♂	19	81.3	10	80.9	2	73.5	4	70.5	4	76.8	—	—	25	82.4
XIII	♀	20	82.2	10	85.2	4	82.8	1	77.0	5	85.6	5	83.4	26	86.3
1934	♂	100	82.8	63	82.1	16	81.3	4	69.0	19	82.5	12	82.0	78	83.0
XIV	♀	183	86.6	69	86.5	18	81.6	3	69.3	25	91.7	15	85.0	112	89.1
1933	♂	5	86.2	1	81.0	1	83.0	—	—	—	—	—	—	4	83.3
XV	♀	9	91.4	2	104.5	1	77.0	—	—	2	90.0	1	86.0	5	89.4
1932	♂	24	87.9	8	84.0	4	83.8	2	77.0	2	92.5	5	85.0	12	84.0
XVI	♀	20	91.6	9	102.9	4	89.8	2	72.5	1	86.0	2	113.5	27	94.2
1931	♂	6	86.8	2	116.0	—	—	—	—	—	—	—	—	1	79.0
XVII	♀	14	93.3	7	96.0	—	—	—	—	—	—	1	95.0	4	108.5
1930	♂	—	—	—	—	—	—	—	—	—	—	—	—	1	123.0
XVIII	♀	4	92.8	1	126.0	—	—	—	—	—	—	—	—	3	94.3
1929	♂	—	—	—	—	—	—	—	—	—	—	—	—	—	—
XIX	♀	2	98.0	—	—	—	—	—	—	—	—	—	—	1	96.0
1928	♂	—	—	—	—	—	—	—	—	—	—	1	90.0	—	—
XX	♀	1	153.0	4	113.5	—	—	—	—	—	—	—	—	—	—
1926	♂	—	—	—	—	—	—	—	—	—	—	1	125.0	—	—
XXII	♀	—	—	3	123.3	—	—	—	—	1	120.0	—	—	—	—
1924	♂	—	—	—	—	—	—	—	—	—	—	—	—	—	—
XXIV	♀	—	—	1	143.0	—	—	—	—	—	—	—	—	—	—

¹⁾ N = Number; M = Average Length in cm.

Comité Atlantique.

INTRODUCTION.

LE Comité Atlantique coordonnera désormais l'activité des trois Sous-Comités dont la création a été décidée lors de la 36ème Assemblée Plénière du Conseil International pour l'Exploration de la Mer à Copenhague (Octobre 1948):

— *le Sous-Comité du Plateau Continental Européen* qui s'occupera des recherches faites sur le Plateau Continental Européen, de St-Kilda jusqu'au Déroit de Gibraltar;

— *le Sous-Comité du Plateau Continental Africain*, qui traitera de celles faites de Gibraltar jusqu'à l'Equateur;

— *le Sous-Comité de la Méditerranée Occidentale* dont l'activité s'étendra dans toute la Méditerranée Occidentale, jusqu'à la ligne imaginaire allant de la Pointe Sud de l'Italie jusqu'à Tripoli en passant par le Cap Passero au sud de la Sicile et l'Île de Malte.

L'époque tardive de l'année à laquelle furent

constitués ces Comités a fait qu'une interprétation générale des résultats des travaux de ces trois Sous-Comités n'est pas encore possible, par suite d'une absence de coordination qui n'a pu se réaliser immédiatement.

Les contributions isolées apportées par:

— M. F. S. Russell, Marine Biological Association of the United Kingdom,

— M. P. Mars, à la Station Biologique de Banyuls sur Mer,

— M. Jean Furnestin et sa collaboratrice: Mlle Marie-Louise Faure, Service Scientifique des Pêches Maritimes, Maroc,

— et MM. L. Faure, Forest, et Letaconnoux de l'Office Scientifique et Technique des Pêches Maritimes, seront donc reprises ici sans qu'il soit tenté d'en tirer des conclusions générales.

Jean Le Gall.

LES CONDITIONS DE MILIEU.

Hydrologie.

Phosphates.

During 1948 the International Hydrographic Station E₁ was worked on twelve occasions for salinity, temperature, inorganic phosphate and total phosphorus. The amount of inorganic phosphate remained low and similar to that present in 1931—39 and 1947. There has evidently been little change in the productive conditions in the area.

Plymouth Laboratory,
Marine Biological Association.

Plancton et Jeunes Poissons.

Plankton and Young Fish.

Plankton catches with the 2 m. stramin ring-trawl in 1948 showed no departure from the general conditions of the previous two or three years. The continued poverty of the hauls was most marked and the numbers of young fish were very low. *Sagitta setosa* was the dominant *Sagitta* sp. Mixed catches of *Muggiaea atlantica* and *M. kochi* were taken, the former species being present for the greater part of the year. In the late summer, small numbers of salps and doliolids occurred.

Plymouth Laboratory,
Marine Biological Association.

Résultats des analyses quantitatives du Zooplancton de la zone côtière marocaine.

Au cours de l'année 1948 il a été procédé à 4 séries trimestrielles de prélèvements au filet à plancton de 30 cm. de diamètre, chaque pêche durant 5 minutes et s'opérant en surface.

Ils ont été effectués suivant 16 lignes perpendiculaires au rivage, du Cap Spartel au Cap Juby aux époques suivantes:

— Prélèvements d'hiver	du 19/I	au 9/III
— Prélèvements de printemps	du 12/IV	au 29/V
— Prélèvements d'été	du 11/VIII	au 7/IX
— Prélèvements d'automne	du 9/XI	au 26/XI

Variations quantitatives saisonnières.

Par ordre de quantité croissante de la masse du plancton, les saisons se rangent dans l'ordre suivant: Été; Hiver — Printemps; Automne.

La dominance d'automne est très marquée.

Variations quantitatives géographiques.

— *Le secteur sud* (du Cap Ghir au Cap Juby) est le plus riche surtout au printemps et en automne.

— *Le secteur nord* (du Cap Spartel à Mazagan) est assez riche, quoique moins que le précédent.

— *Le secteur central* est le plus pauvre, sauf en automne où le plancton est assez abondant.

Analyses Quantitatives (en cm.³).

	Lignes	Hiver	Printemps	Été	Automne
Secteur nord	Spartel	10	10	1	9
	Arcila	8	6	9	10.5
	M. B. Selham	20 + (50)	12.5	6	42
	Sebou	16	8.5	9	28
	Fedala	—	10 + (50)	16	9.5
	Casablanca	8.5	2 + (100)	1	17.5
	Mazagan	14	12 + (100)	1	10.5
Secteur central	Safi	14	3	11	22.5 + (100)
	Mogador	11.5	4 + (100)	16	29.5 + (50)
Secteur sud	C. Ghir	21.5	12	5	13.5
	Agadir	6	—	0.5	—
	Massa	25.5	3.5	4	9.5
	Ifni	7	40	38	21
	Draa	8	41	4.5	8
	Cansado	—	—	0.5	28 + (100)
	Juby	32	42 + (100)	6.5	150
	Total:	202 + (50)	206.5 + (450)	129	409 + (250)

(Les chiffres marqués entre parenthèses indiquent le volume des salpes séparées du reste du plancton.)

Comparaison sommaire avec l'année 1947.

- 1) L'automne pendant ces 2 années s'est révélé la saison la plus riche en plancton.
- 2) Par contre le minimum de l'hiver 47 n'apparaît pas en 48; il est remplacé par un minimum d'été.

(La richesse relative de nos prélèvements d'hiver 48 pourrait s'expliquer par le fait qu'ils ont été pratiqués assez tard alors que les températures commençaient à s'élever notable-

ment ramenant des conditions hydrologiques voisines de celles du printemps).

- 3) La richesse du secteur sud et la pauvreté du secteur central rappellent absolument les faits observés en 1947.
- 4) Au total le plancton recueilli au cours de l'année 1948 est sensiblement aussi abondant que celui prélevé pendant l'année 1947.

Marie-Louise Faure.

LES POISSONS.**Gadidés.****Merlu. (*Merlucius merluccius*).****Composition du Stock de Merlu en 1948.**

La question importante qui se pose actuellement pour les pêcheries de la Mer Celtique et du Golfe de Gascogne est celle de la diminution notable du rendement des captures de merlu.

Nous avons essayé de déterminer l'importance de cette diminution et, en même temps, de donner une image de la composition du stock présent en 1948 sur les fonds de pêche.

1. Diminution des captures.

Les documents que nous possédons permettent de fixer comme suit la moyenne des captures annuelles par sortie de 14 jours environ pour un chalutier de type ancien de 300 tonnes.

Apports moyens par sortie (tonnes).

	Total	Merlu	Merluchon	‰ de Merluchon
1937—39	9.6	6.4	3.2	34
1946	23.3	19.1	4.2	18
1947	14.0	10.4	3.6	25
1948	8.9	6.0	2.8	32

Il apparaît tout de suite une importante diminution des apports. En 1948, 62 ‰ des captures de 1946 n'existent plus et le tonnage débarqué par sortie a été ramené à un niveau inférieur à celui des années d'avant guerre. Cette baisse brutale traduit l'importance de la destruction du riche stock de merlu qui s'était accumulé au cours de la dernière guerre.

Si l'on établit la distinction entre merlu et merluchon, c'est à dire entre gros et petit, la séparation commerciale se fait sur les individus de 900 g. ce qui correspond à une taille de 55 cm. environ.

Dans ces conditions si l'on calcule le pourcentage que chacune de ces catégories représente dans les apports, on constate une diminution très nette du nombre de gros merlus et par contre une augmentation proportionnelle du nombre de merluchons dont le pourcentage passe de 1946 à 1948 de 18 à

25 puis à 32 ‰, rejoignant ainsi le pourcentage d'avant guerre: 34 ‰.

Cette perte de 14 ‰ en trois ans des apports de merlu témoigne d'une diminution de la taille moyenne du stock.

2. Composition du stock.

1. Mensurations. Les mensurations effectuées depuis 1946 peuvent être facilement comparées aux mensurations données par Hickling pour 1937, une sortie d'un chalutier hauturier de La Rochelle correspondant à un peu plus de 200 heures de pêche (tableau 1).

En 1937, le stock se composait principalement de merluchons entre 30 et 55 cm. Les gros merlus étaient peu nombreux et un petit nombre seulement d'entre eux atteignaient la taille de 90 cm. (Fig. 1).

En 1946, la taille moyenne du stock de merluchons était de 42 cm. ce qui correspondait à des poissons de 450 g. (vidés). La moyenne des apports étant par marée de 4.2 tonnes cela représentait environ 9,200 poissons. Pour les merlus un même calcul donne une taille moyenne de 66 cm. (1,650 g.) soit pour des apports de 19.1 tonnes un nombre estimé de 11,600 poissons. Les mensurations montrent que ce stock s'étalait avec une égale richesse sur une longue gamme de tailles allant de 30 à 80 cm. et que les merlus atteignant 100 cm. étaient encore assez nombreux.

En 1948, le même calcul nous donne par sortie des captures de 5,600 merluchons et de 2,400 merlus.

	Apports tonnes	Taille moyenne cm.	Poids moyen g.	Nombre d'individus
1946				
Merluchons	4.2	42	450	9,300
Merlus	19.1	66	1,650	11,600
1948				
Merluchons	2.8	43	500	5,600
Merlus	6.0	74	2,400	2,500

Le second graphique de la figure 1 donne une image de ce stock tel que nous l'estimons d'après les données précédentes et les mensurations effectuées.

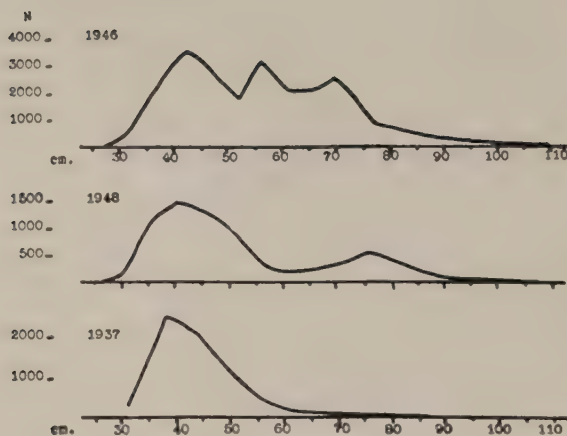


Fig. 1. Stocks comparés = 1946—1948 (original) et 1937 (d'après Hickling). Nombre de merlus par groupes de 5 cm. par sortie.

Tableau 1.
Mensurations effectuées en 1948
(La Rochelle).

Date et Origine	2 II au 9 III Golfe 45° à 46°30 (110-120 et 250-300 m.)	11 au 16 II Golfe 45° à 46° (105-130 m.)	8 au 10 V Bishop Melville Petite Sole	30 VI NW. Ile d'Yeu	14 au 28 VI Grande Sole
cm.					
15	—	1	—	—	—
20	—	172	—	49	—
25	—	394	—	686	7
30	2	95	8	198	12
35	24	77	49	24	90
40	244	136	118	17	130
45	266	54	159	19	118
50	103	10	124	7	97
55	92	3	105	—	67
60	70	11	70	—	48
65	50	5	70	—	55
70	47	6	82	—	64
75	38	10	62	—	91
80	27	15	47	—	79
85	15	5	41	—	52
90	13	3	34	—	34
95	5	2	13	—	27
100	2	1	10	—	21
110	2	—	—	—	1
105	0	—	1	—	7
t:	1000	1000	1000	1000	1000
N (6156)	1033	1026	993	414	2690

Il possède encore quelques individus de bonne taille mais ceux-ci sont en diminution numérique importante et il n'est malheureusement que trop visible que l'on se rapproche d'un stock tel que le figurait Hickling en 1937.

On constate en effet qu'à l'exception d'une bonne classe autour de 80 cm. le stock de gros merlus est considérablement réduit et que, comme avant guerre, un faible nombre de merlus arrive à dépasser la taille de 60 cm. La presque totalité de la riche partie du stock qui s'étendait entre 55 et 80 cm. n'existe plus.

2. Classes d'âge. La détermination des divers groupes d'âge a été effectuée grâce à l'examen de près de 1,200 otolithes.

a) *Mer Celtique.* A la fin de 1947 la pêche portait principalement sur un important stock de merluchons qui, dans la région de Jones Bank, se composait d'individus de trois à sept ans. En valeur numérique la classe 1943 dominait (quatre ans) mais les classes 42 et 44 étaient également bien fournies.

Dans la même région et dans la région des "Soles", en Juin 1948, nous retrouvons ces trois classes dominantes dans les apports de merluchons. Quant aux captures de merlus elles portaient sur des poissons de sept à treize ans dont les plus nombreux se groupaient autour de la classe 1939. (Fig. 2 A et tableau 2).

Tableau 2.
Composition du Stock en Juin 1948
en Mer Celtique.

Age	3	4	5	6	7	8	9	10	11	12	13
Classes	45	44	43	42	41	40	39	38	37	36	35
cm.											
25	2	—	—	—	—	—	—	—	—	—	—
30	—	2	—	—	—	—	—	—	—	—	—
35	—	27	3	—	—	—	—	—	—	—	—
40	—	34	16	—	—	—	—	—	—	—	—
45	—	29	35	1	—	—	—	—	—	—	—
50	—	8	36	20	1	—	—	—	—	—	—
55	—	—	23	41	5	—	—	—	—	—	—
60	—	—	2	23	15	1	—	—	—	—	—
65	—	—	—	9	11	5	1	—	—	—	—
70	—	—	—	2	16	16	3	1	—	—	—
75	—	—	—	1	12	26	19	4	—	—	—
80	—	—	—	—	2	11	23	8	1	—	—
85	—	—	—	—	—	—	11	10	3	—	—
90	—	—	—	—	—	—	5	8	6	2	—
95	—	—	—	—	—	—	3	5	4	3	1
100	—	—	—	—	—	—	—	3	3	2	2
105	—	—	—	—	—	—	—	—	1	1	—
Total:	2	100	115	97	62	59	65	39	18	8	3
0/0:	0.5	18	21	17	11	10	11	7	3	1	0.5
Taille											
moy.	25	40	47	56	66	73	80	86	92	96	98
(Grande Sole)											

Cette classe 1939 a joué un rôle important ces deux dernières années car c'est elle qui a donné, avec la classe 1938, les bons apports de merlu de 1946 et, dans une certaine mesure, de 1947. Cette année elle a encore donné un petit nombre de merlus autour de 80 cm, comme le montrent les mensurations précédentes. Elle est malheureusement sur son déclin et est suivie de deux classes qui sont loin de la valoir et sont vraisemblablement responsables du peu de poissons entre 60 et 70 cm. (1940—41).

Il résulte de ces observations qu'il ne faut compter sur aucune amélioration des apports de gros merlus en 1949 et que seules les classes 1942 à 1944 sont susceptibles d'assurer le maintien du stock.

b) *Golfe de Gascogne*. Dans le Golfe de Gascogne le stock semble relativement plus pauvre qu'en Mer Celtique. En Février les classes 1943—42 fournissaient près de la moitié des apports et les merlus de bonne taille étaient peu nombreux. (Fig. 2 B et tableau 3).

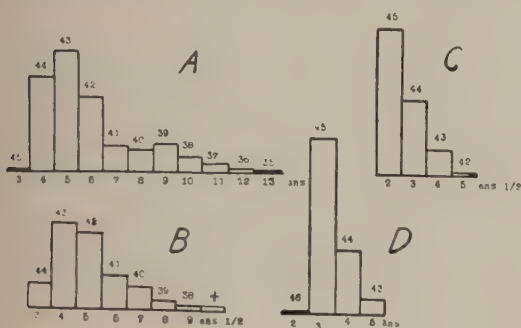


Fig. 2. Distribution par classes des merlus:

A, de la Mer Celtique (corrigé d'après le tableau 2 A et le stock estimé),

B, du Golfe de Gascogne,

C, en zone côtière en Février,

D, en zone côtière en Juin.

En zone côtière l'action des petits chalutiers s'exerceait sur un stock beaucoup plus réduit, mais jeune, puisque la majorité des apports (classe 45) était formée de poissons ayant trois ans en Juin. Ceux de quatre et cinq ans étaient bien moins nombreux. (Figs. 2 C et D et tableaux 4 et 5).

5. Croissance.

La courbe de croissance que nous obtenons pour le merlu de la Mer Celtique est tout à fait comparable à celle déjà donnée par Hickling pour ce secteur. En ce qui concerne la population du Golfe de Gascogne sa croissance est plus rapide que celle de la population de la Mer Celtique. Ce fait a déjà été établi par Bello c mais les résultats que nous obtenons sont quelque peu inférieurs aux siens. (Fig. 3).

Tableau 3. Composition du Stock en
Février 1948 dans le Golfe de Gascogne.

Age	3	4	5	6	7	8	9 ans 1/2
Classes	44	43	42	41	40	39	38
cm.							
30	2	—	—	—	—	—	—
35	3	—	—	—	—	—	—
40	18	30	—	—	—	—	—
45	10	60	18	—	—	—	—
50	—	12	18	2	—	—	—
55	—	26	38	7	—	—	—
60	—	6	35	9	—	—	—
65	—	1	14	11	2	—	—
70	—	—	7	11	4	—	—
75	—	—	—	9	10	—	—
80	—	—	—	4	9	2	—
85	—	—	—	—	4	5	—
90	—	—	—	—	—	5	—
95	—	—	—	—	—	—	2
100	—	—	—	—	—	1	1
105	—	—	—	—	—	—	—
110	—	—	—	—	—	—	1
Total:	33	135	130	53	29	13	4
0/0:	9	34	32	13	8	3	1
Taille moy:	40	47	56	66	76	87	100

(Golfe: 45° à 46°30, 150 à 300 m).

Tableaux 4 et 5.
Composition du Stock en Février et Juin
1948 dans le Golfe de Gascogne.

Age	2	3	4	5 1/2	2	3	4	5 ans
Classes	45	44	43	42	46	45	44	43
cm.								
15	1	—	—	—	—	—	—	—
20	36	4	—	—	—	2	—	—
25	51	21	—	—	1	41	3	—
30	4	9	—	—	—	7	4	—
35	1	8	1	—	—	1	1	—
40	—	4	4	—	—	—	7	—
45	—	1	8	—	—	—	4	2
50	—	—	3	2	—	—	—	2
55	—	—	—	1	—	—	—	—
Total:	93	47	16	3	1	51	19	4
0/0:	58	30	10	2	1	68	25	6
Taille moy.	23	28	44	51	—	25	36	48

(Golfe: 45° à 46°.
105 à 130 m.)

(Golfe: NW.
Ile d'Yeu)

4. Conclusion.

Le riche stock de merlu qui existait sur les pêcheries à la fin de la dernière guerre est déjà, trois ans seulement après la reprise intensive de la pêche, ramené au niveau de 1937—39.

Sparidés.

Observations diverses sur la Dorade (*Pagellus centrodontus*).

Les mensurations ont été effectuées à terre en Octobre, Novembre et Décembre 1947 et Janvier, Février, Mars, Mai et Juin 1948 sur 9,189 individus pris dans les pêches débarquées au port de La Rochelle. Une partie de ces dorades provenait de l'entrée de la Manche ("Jones Bank" en Octobre, Novembre et Décembre; "Grande Sole" en Février; "Petite Sole" et "Melville" en Mai et "Grande Sole" en Juin. Un lot étudié en Mars avait été pêché dans le canal St-Georges).

L'autre partie a été capturée dans le Golfe de Gascogne où nous avons fait deux divisions: poissons pêchés dans la zone côtière par moins de 100 mètres de fond (Golfe I) et poissons pêchés par plus de 100 mètres (Golfe II).

Dans la zone côtière, en Octobre et Novembre, nous trouvons une classe de taille modale 16 cm. (une première étude des écaillés nous a montré que ces individus appartiendraient au groupe II) qui représente la presque totalité des pêches; une autre classe de taille modale 21 cm. existe aussi.

En Décembre, les bateaux travaillant dans cette zone ne pêchent pour ainsi dire plus de petites dorades. Ces individus sont descendus plus creux; le groupe de taille modale 21—22 cm. est bien indiqué sur la courbe établie pour le mois de Décembre (Golfe II). L'allure de cette courbe montre que le

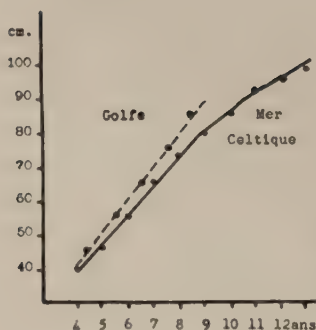


Fig. 3. Courbes de croissance des merlus du Golfe de Gascogne et de la Mer Celtique.

Le merlu pouvant atteindre l'âge de douze ans la pêche porte en période de stock riche sur des individus de trois à neuf ans. C'est ce qui avait lieu en 1946. Malheureusement le stock s'épuise très vite et la flotte importante qui a été en activité depuis la fin de la guerre n'a laissé en nombre que des poissons de trois à six ans.

Dans ces conditions, la grande majorité des apports de 1948 se composait, en zone côtière, d'individus de trois à quatre ans et, sur les pêcheries du large, de quatre à six ans. Le nombre de merlus de plus de sept ans entrant dans les captures était extrêmement réduit.

La chute brutale des apports au cours de ces trois dernières années peut donc s'expliquer par la diminution numérique de l'ensemble du stock et, en particulier, des individus de plus de sept ans.

R. Letaconnoux.

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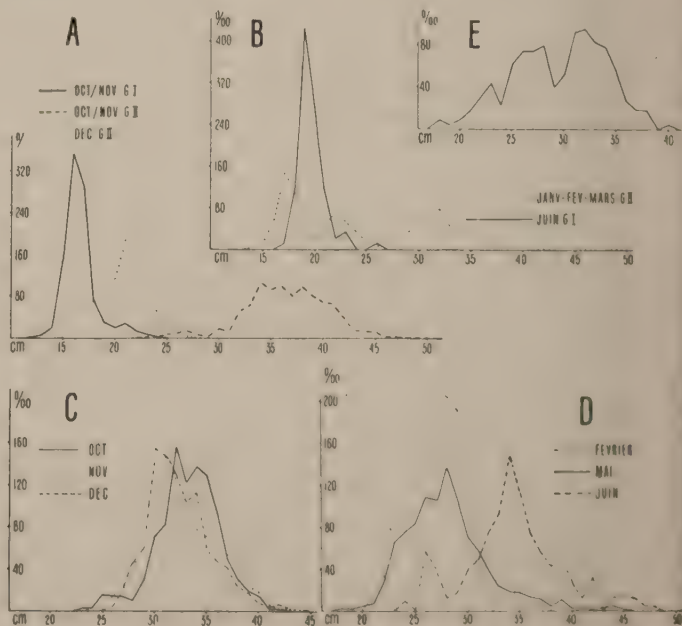


Fig. 4. Répartition des tailles des dorades capturées.

A et B, dans le Golfe de Gascogne, C et D, à l'entrée de la Manche et E, dans le Canal de St-Georges.

groupe de taille 16—17 cm. se rencontre également, de même qu'une autre classe de taille modale 26—27 cm. qui est aussi indiquée sur la courbe Octobre—Novembre Golfe II. Pour les tailles supérieures, l'interprétation devient plus difficile et nous n'avons pas encore de données suffisantes; il y aurait une classe à 30 cm.

Au premier trimestre 1948, les mêmes groupes se retrouvent: 17 cm., 22 cm., mais les individus les plus grands ont disparu; peu d'individus de taille supérieure à 37 cm. Au mois de Juin, nous retrouvons

en zone côtière le groupe qui avait une taille modale de 16—17 cm., mais le mode est maintenant 19 cm.: ces individus ont grandi depuis l'hiver.

A l'entrée de la Manche, on constate une arrivée d'individus moins âgés au fur et à mesure que la saison s'avance: la courbe se déplace légèrement vers la gauche, le sommet principal passe de 32 cm. en Octobre à 31 cm. en Novembre, 30 en Décembre à "Jones Bank", 28 cm. en Février à la "Grande Sole"; 28 cm. également avec pourcentage élevé d'individus plus petits en Mai à la "Petite Sole" et "Melville".

Au mois de Juin à la "Grande Sole", les classes sont plus mélangées; il y a eu une arrivée d'individus plus âgés; sommet principal de la courbe à 34 cm.

Tableau 6. Golfe de Gascogne.

cm.	G. I Oct. + Nov. 0/00	G. II Oct. + Nov. 0/00	G. II Dec. 0/00	G. II Janv. + Févr. + Mars 0/00	G. I Juin 0/00
10	—	—	—	—	—
1	1	—	—	—	—
2	2	—	—	—	—
3	5	—	—	—	—
4	21	—	—	4	—
5	153	—	3	11	—
6	348	—	23	57	—
7	291	—	63	145	11
8	73	—	71	110	114
9	31	—	85	25	420
20	20	—	115	21	273
1	28	—	190	46	114
2	16	2	211	70	23
3	7	2	131	51	34
4	2	3	53	34	—
25	—	8	24	15	—
6	1	10	26	7	11
7	—	14	5	12	—
8	1	7	—	18	—
9	—	3	—	33	—
30	—	19	—	57	—
1	—	14	—	68	—
2	—	52	—	76	—
3	—	64	—	46	—
4	—	109	—	38	—
35	—	97	—	21	—
6	—	100	—	14	—
7	—	83	—	6	—
8	—	100	—	6	—
9	—	83	—	3	—
40	—	70	—	2	—
1	—	65	—	1	—
2	—	41	—	1	—
3	—	16	—	—	—
4	—	15	—	—	—
45	—	14	—	—	—
6	—	3	—	1	—
7	—	3	—	—	—
8	—	1	—	—	—
9	—	1	—	1	—
50	—	1	—	—	—
N	1.831	865	649	1.962	88

Tableau 7. Entrée de la Manche.

cm.	Oct. 0/00	Nov. 0/00	Déc. 0/00	Févr. 0/00	Mai 0/00	Juin 0/00	Mars (Canal St. Georges) 0/00
16	—	—	—	—	—	—	—
7	—	—	—	—	1	—	—
8	—	—	—	—	2	—	9
9	—	—	—	—	2	—	4
20	—	—	—	—	4	—	9
21	—	—	—	13	6	—	18
2	—	—	—	33	27	—	31
3	2	—	—	—	64	—	44
4	2	2	—	13	76	9	22
25	15	2	1	39	83	—	62
26	14	13	5	72	108	57	75
7	14	25	22	191	106	40	75
8	10	42	45	204	136	13	80
9	30	82	60	191	108	18	40
30	71	99	155	131	70	40	53
31	82	154	148	39	57	49	93
2	157	127	131	13	39	75	97
3	123	93	105	26	24	93	84
4	138	79	113	7	18	146	80
35	130	71	60	7	17	115	57
36	94	51	48	7	13	75	27
7	49	54	42	7	11	57	18
8	30	52	24	—	4	44	18
9	20	25	18	—	10	49	—
40	15	19	9	—	2	27	4
41	2	6	5	7	4	13	—
2	2	2	7	—	1	31	—
3	—	2	1	—	2	—	—
4	—	—	1	—	4	13	—
45	—	—	—	—	1	13	—
46	—	—	—	—	—	13	—
7	—	—	—	—	—	5	—
8	—	—	—	—	—	5	—
9	—	—	—	—	—	—	—
50	—	—	—	—	—	—	—
N	593	479	914	152	1,203	227	226

lieux de pêche subissaient un renouvellement progressif: départ de poissons arrivés à un certain degré de maturité (stades III-IV) et apparition de poissons au début de leur évolution sexuelle (stades I—II).

La différence du degré de maturité moyen entre mâles et femelles du groupe I est indiquée ci-dessous:

	19	24	10	8	2	24	24	28	12
	Mai	Mai	Juin	Juillet	Août	Août	Août	Oct.	Nov.
♂ ♂	IV-0	II-6	II-6	II-3	I-9	I-9	I-8	III-5	III-0
♀ ♀	II-8	II-6	II-7	II-1	II-5	II-5	II-4	III-3	III-0

4. Caractères de croissances.

Bien que les valeurs de l_1 , l_2 , l_3 aient été calculées pour les individus de chaque groupe d'âge, nous ne donnerons ici que les résultats obtenus pour le groupe I, le plus important numériquement.

Les fréquences ($^{0/00}$) des différentes valeurs de l_1 calculées en mm. et ramenées au $\frac{1}{2}$ cm. le plus proche, comme pour les tailles, ainsi que les valeurs moyennes, sont données dans le tableau 10.

Il est particulièrement intéressant de comparer les parties droite et gauche de la figure 6. L'une donne la variation des valeurs de l_1 dans chaque échantillon, l'autre la variation des tailles. On constate qu'il y a simultanément diminution de la valeur de l_1 (jusqu'en Août) et accroissement de la taille moyenne. La valeur moyenne de l_1 décroît constamment du 19 Mai (12.9 cm.) au 2 Août (9.10 cm.) Elle varie ensuite beaucoup moins, restant comprise entre 9.55 et 9.85 cm. De plus à partir

du mois d'Août, on se trouve en présence de populations beaucoup moins homogènes au point de vue des valeurs de l_1 . C'est ce que montre l'aplatissement et l'étalement des derniers polygones de variation.

L'étude de la croissance après la formation du 1er anneau d'hiver ne peut être basée sur l'accroissement des tailles moyennes, par suite du renouvellement de population signalé plus haut.

Le calcul des valeurs moyennes de t_2 dans chaque lot aboutit également à des résultats faussés pour la même raison: en effet, il y a en général croissance compensatrice au cours de la 2ème année (F u r n e s t i n), les poissons à faible valeur de l_1 grandissant plus vite que les poissons à valeur élevée de l_1 . Nous avons calculé les valeurs moyennes de t_2 pour 2 classes de valeurs de l_1 représentées dans tous les échantillons; le tableau ci-dessous donne les valeurs moyennes de l_1 et de t_2 pour les poissons qui avaient 11.0 et 11.5 cm. à la formation du premier anneau d'hiver.

	24	10	8	2	24	28	12
	Mai	Juin	Juillet	Août	Août	Oct.	Nov.
l_1	11.4	11.3	11.2	11.0	11.1	11.35	11.2
t_2	2.84	3.38	3.98	4.35	4.98	6.11	6.09

D'après ce tableau a été tracée la courbe de croissance de la figure 7 où a été également représentée à titre comparatif (en traits interrompus) la courbe établie d'après des valeurs moyennes de t_2 dans chaque lot.

On voit à quel point ces 2 courbes diffèrent et à quel point l'interprétation de la croissance réelle

Tableau 10.

Fréquences des valeurs de l_1 ($^{0/00}$) pour les sardines à 1 anneau d'hiver.

Echantillon No.	1	2	3	4	5	7	8	9	10
Date 1948	19/V	24/V	10/VI	8/VII	2/VIII	24/VIII	24/VIII	28/X	12/XI
Nombre	34	66	64	79	101	49	49	92	75
Taille en cm.									
6	—	—	—	—	30	20	—	—	—
6.5	—	—	—	—	30	41	—	11	—
7	—	—	—	—	20	20	—	43	67
7.5	—	—	—	—	79	41	82	76	28
8	—	—	—	13	89	82	82	43	120
8.5	—	—	—	25	198	82	82	141	147
9	—	—	—	38	89	82	143	87	107
9.5	—	—	16	76	129	204	82	120	67
10	—	15	62	152	99	82	122	76	53
10.5	29	121	78	152	99	184	61	98	67
11	29	76	188	203	89	20	184	65	147
11.5	118	136	188	190	20	61	61	98	93
12	118	136	250	76	30	41	61	76	13
12.5	88	288	141	63	—	41	20	33	40
13	206	182	47	13	—	—	20	33	53
13.5	206	30	—	—	—	—	—	—	—
14	118	15	31	—	—	—	—	—	—
14.5	88	—	—	—	—	—	—	—	—

Tableau 11. Vertèbres et valeurs moyennes de l_1 .

Date	Groupe	n	51	Individus à 52 53 Vertèbres	54	m. + fl. m.	Taille (gr. 0) l_1 (gr. I) cm.
19/V	0	80	11.3	73.8	15.0	—	52.04 ± 0.19
24/V	1	66	6.1	57.6	34.8	1.5	52.32 ± 0.25
10/VI	1	66	6.1	63.6	24.2	6.1	52.30 ± 0.28
8/VII	1	112	8.9	53.6	35.7	1.8	52.30 ± 0.22
2/VIII	1	100	14.0	60.0	26.0	—	52.12 ± 0.21
24/VIII	1	49	10.2	73.5	16.3	—	52.06 ± 0.23
28/X	1	81	11.1	59.3	29.6	—	52.17 ± 0.23
12/XI	1	75	12.0	64.0	24.0	—	52.12 ± 0.23

de la sardine peut être altérée par une telle représentation.

5. Vertèbres.

Le tableau 11 donne les fréquences et moyennes vertébrales pour le groupe 0 (échantillon No. 6) et pour le groupe I (échantillons No. 2, 3, 4, 5, 8, 9, 10).

Plusieurs constatations s'imposent: à l'intérieur du groupe I, les individus à 51 vertèbres sont plus fréquents au fur et à mesure que la saison s'avance, c'est le contraire pour les individus à 54, qu'on ne trouve plus à partir du mois d'Août. La moyenne décroît régulièrement de Mai à Août, elle varie ensuite dans l'un ou l'autre sens, sans atteindre la

Nous ne voulons ni généraliser, ni, pour l'instant, interpréter ces constatations. Nous rappellerons simplement que Furnestin a observé de telles variations concomitantes de la moyenne vertébrale et de l_1 chez les sardines de St-Jean-de-Luz. (1943).

D'autre part, le calcul de la valeur moyenne de l_1 pour chaque groupe vertébral nous a donné les résultats suivants:

Individus à	n	l_1
51 vertèbres	45	90.8
52 "	271	10.35
53 "	114	10.60
54 "	5	(10.85)

J. Forest.

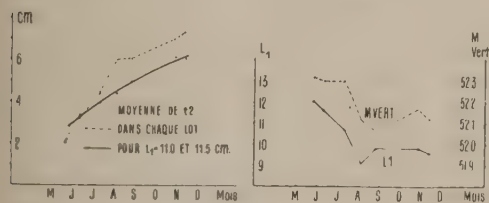


Fig. 7. Croissance au cours de la saison de pêche.

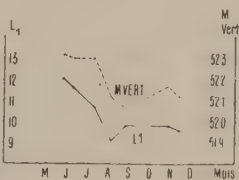


Fig. 8. Variations des valeurs moyennes de L_1 et des moyennes vertébrales au cours de la saison de pêche.

La Formule vertébrale des Sardines du Maroc pendant l'année 1948.

Vertèbres	Fréquence			Total
	Casablanca	Safi	Agadir	
48	2	—	—	2
49	26	4	2	32
50	804	167	113	1,084
51	1,471	267	173	1,911
52	113	14	17	144
53	—	1	—	1
Nombre total:	2,416	453	305	3,174

Moyenne
vertébrale

50-690	50-649	50-673	50-683
$\sigma \pm$	0.68	0.56	0.58
$Fl \pm$	0.04	0.08	0.12
			0.03

Les chiffres de ce tableau témoignent d'une remarquable régularité de la formule vertébrale sur toute l'étendue du secteur Atlantique Marocain dont les divers groupements de sardines constituent une race (la Race Marocaine) bien individualisée et très homogène.

J. Furnestin.

valeur de Juillet. Il est surtout intéressant de comparer ces fluctuations à celles des valeurs moyennes de l_1 (Fig. 8). Le renouvellement de population de Mai à Août y est particulièrement visible. Quant au groupe 0, l'échantillon observé en Juillet présente une faible moyenne vertébrale, alors que le groupement qu'il représente aura une forte valeur de l_1 (de 13 à 13.5 cm. au moins). De même, chez les individus du groupe 0 contenus dans l'échantillon du 28 Octobre, trop peu nombreux ($n = 20$) pour que nous l'ayons fait figurer au tableau 11; on a une valeur de la moyenne vertébrale particulièrement faible ($m = 51.80$) pour une valeur de l_1 présumée très forte (taille moyenne = 14.45 cm.).

Contribution à l'étude de l'évolution d'un Etang Méditerranéen.

Malacologie de l'Etang de Berre.

(Résumé).

Par

P. Mars.

ORIGINAL par son allure d'enclave maritime à l'intérieur des terres, l'étang de Berre, qui, dans le département des Bouches-du-Rhône, occupe une superficie de 15.000 Ha environ, est encore remarquable par son histoire géologique relativement complexe et par les transformations successives des conditions de milieu, donc de la faune.

Dès 1882, les étapes de la formation de l'étang ont été reconnues en gros par Collot¹⁾, puis elles ont été précisées par Denizot²⁾ qui a mis en évidence la régression pré-flandrienne, dernière et importante phase du creusement de l'étang. La terrasse de Martigues, formation que les géologues admettent représenter un niveau local de 9 m., et qu'ils datent du Monastirien, est antérieure à cette régression. Elle témoigne d'une phase à faciès lagunaire accentué, tandis que les sédiments déposés après la transgression flandrienne offrent d'abord une faune marine, qui devient ensuite de plus en plus saumâtre, jusqu'à ce que l'homme, en intervenant dans les conditions topographiques à partir de 1855 ne provoque une évolution inverse, particulièrement marquée lorsqu'en 1926 est achevé le canal souterrain du Rove.

Dans la terrasse des Martigues, les seuls fossiles appartenant avec certitude à cette formation sont *Cardium edule* L. et des Hydrobiidae. *Cardium edule* offre là de grandes analogies de formes avec les échantillons vivant actuellement en Camargue. Il s'apparente à la variété *rectidens-varnensis* Coen.

Dans la partie méridionale du Jai, cordon littoral séparant l'étang de Berre de l'étang de Bolmon, la faunule subfossile recueillie dans un "niveau inférieur" correspondant au maximum atteint par la transgression flandrienne (1 à 2 m. dans la région) est remarquable par l'abondance de *Venus gallina* L. à laquelle s'ajoutent une vingtaine d'espèces, parmi lesquelles *Bittium reticulatum* (D. C.) et *Cyclonassa neritea* (L.) sont les plus communes, puis *Corbula mediterranea* (Costa). L'assemblage des espèces est sensiblement différent de celui rencontré

dans les dépôts coquilliers de la plage actuelle. On est ici en présence, pour le même lieu, d'une succession d'association dans le temps. Cette succession rappelle de près celle observée dans le nord de l'Adriatique, où, dans l'espace, une "biocénose" marine à *Venus gallina* cède la place, lorsqu'on pénètre dans la lagune, à d'autres "biocénoses" à *Tapes*, à *Cardium*, etc.

La faunule rencontrée dans les vases flandriennes retirées de la rade de Port-de-Bouc, au cours de travaux récents (1948) est bien plus variée. Sur un total de 63 espèces recueillies, 37 ne font plus partie de la faune actuelle en ce même lieu. Parmi ces espèces disparues, sont particulièrement communes: *Gibbula ardens* (Salis), *Phasianella speciosa* (v. Mühlf.), *Rissoa variabilis* (v. Mühlf.), *Alvania cimex* (L.), *Murex brandaris* (L.), *Nassa ferrussaci* (Payr.), *Pusia tricolor* (Gm.), *Propeamussium hyalinum* (Poli), *Venus verrucosa* L. Les vases recueillies en différents points de l'étang de Caronte sont déjà moins riches en espèces, mais permettent de recueillir également quelques formes disparues de l'étang: *Turritella communis* Risso, *Aporrhais pespelecanis* (L.), *Murex brandaris* (L.), ainsi que d'autres aujourd'hui devenues moins communes.

Les études successives de Marion en 1886—1887¹⁾, Gourret 1897—1907²⁾, Chevallier 1916³⁾ avaient fourni des renseignements suffisants pour pouvoir comparer le milieu et la faune d'alors au milieu et à la faune actuels. Les données concordantes de ces auteurs permettent de se rendre compte d'une légère et progressive augmentation de la salinité entre 1855 et 1912. A cette dernière date, la valeur moyenne de la salinité était d'environ 25 ‰. Moins de dix ans après l'ouverture du tunnel du Rove, faisant communiquer l'étang de

¹⁾ Marion, A. F. — "Discours de réception prononcé le 30 Mai 1886." Acad. Sci. Belles Lettres et Arts de Marseille (1887).

— "Faune malacologique de l'étang de Berre." C. R. Acad. Sci., CV (1887).

²⁾ Gourret, P. — "Topographie zoologique des étangs de Caronte, de Labillon, de Berre et de Bolmon." Ann. Mus. Hist. Nat. Marseille, XI (1907).

³⁾ Chevallier, A. — "L'étang de Berre." Ann. Inst. Océanogr. VII f. 4 (1916).

¹⁾ Collot, L. — "Histoire quaternaire et moderne de l'étang de Berre." B. S. G. F. 3^e s. X., p. 333.

²⁾ Denizot, G. — "La Crau, la Camargue et l'étang de Berre. Etude géologique." Trav. Lab. Géol. Fac. Sci. Marseille, II, p. 5—161 (1939).

Berre avec le Golfe de l'Estaque, Van Gaver et Timon-David¹⁾ enregistraient les premières tendances de l'évolution des milieux et des populations animales vers des types plus marins. Au cours des recherches organisées par le Laboratoire pour l'étude biologique de la Camargue et des étangs méditerranéens, mes études sur la faune malacologique de l'étang de Berre m'ont amené à préciser l'état actuel de la salinité et m'ont permis de recueillir de nombreuses espèces qui autrefois ne pénétraient pas dans cet étang.

Dans sa partie centrale, l'étang de Berre offre une salinité relativement constante, égale en moyenne à 32-4, tandis qu'elle est voisine de 37 à 38 dans le Golfe de Marseille. La région de St-Chamas, autrefois décrite comme presque douce, est aujourd'hui aussi salée que le reste de l'étang. Seuls, les voisinages immédiats des estuaires (Arc, Touloubre, canaux d'Istres), connaissent de faibles salinités. L'étang de Bolmon a des eaux de salinité très variable selon l'époque considérée, 8 et 33-5 ‰ étant les valeurs extrêmes notées. Le canal maritime de Caronte, et à un degré moindre, le tunnel du Rove, sont le siège de courants grâce auxquels les eaux intérieures tendent à acquérir les mêmes caractères physico-chimiques que ceux des eaux marines, sans cependant y jamais parvenir.

Dans sa totalité, l'étang de Berre correspond à un "bios des régions reentrantes" (Fischer-Piette), caractérisé non par le mode abrité, mais par les qualités bio-chimiques des eaux. Les trois faciès, rocheux, sableux, vaseux, y sont représentés, le premier médiocrement, le second assez bien dans la région du Jai, tandis que les fonds vaseux occupent la plus grande superficie. Ils sont, jusqu'à la profondeur de 5—6 m. recouverts par les Zostères. La zone centrale vaseuse atteint, sur 3.000 Ha., la profondeur uniforme de 9 m.

La liste préliminaire suivante, pâle reflet certainement de la nouvelle richesse faunistique de l'étang, dénote néanmoins l'importance des modifications subies par la faune.

Echinodermes.

Astropecten bispinosus (Otto), Port-de-Bouc et Martigues (Van Gaver et Timon-David 1934); Tholon, Figuerolles (1947—48).

Astropecten irregularis-pentacanthus (D. Cj.), Tholon, le Jai (1947—1948).

Ophiothrix fragilis (Abild) Martigues, le Jai (1948);

Psammechinus microtuberculatus (Blv.) Cette espèce ne pénétrait pas du tout dans l'étang de Caronte, tandis que *Paracentrotus lividus* faisait quelques apparitions, sans se répandre au-delà de Martigues. Actuellement, les deux espèces se

rencontrent aussi bien dans le Grand-Etang que dans Vaine ou dans le Golfe de St-Chamas.

Amphiura mediterranea Lyman. En 1921, Koehler avait déjà cité l'espèce dans l'étang. Retrouvée aux Trois-Frères et au Jai.

Labidoplax thompsoni (Herapath). Le Jai (1947). Prenant¹⁾ indique que cette espèce semble exiger des sables durs et presque exempts de calcaire. Cependant, la réserve qu'il exprime (*loc. cit.* p. 74) est justifiée: "... Ces indications ne sont évidemment pas définitives et les limites écologiques qu'elles cherchent à fixer sont sujettes à varier en extension. Si je les donne, c'est-à-titre d'hypothèse de travail et il est souhaitable qu'elles soient contrôlées en d'autres lieux comme le permet, je crois, leur précision". Les sables de l'étang de Berre dans lesquels l'espèce a été trouvée, sont fortement calcaires. On y rencontre encore d'autres espèces que Prenant n'avait rencontrées que dans des sables non calcaires: *Astropecten irregularis*, *Macoma tenuis*, *Spisula subtruncata*...

Vers Annelides polychètes.

Pectinaria koreni Mlmgr — Fonds vaseux du Grand-Etang; Golfe de St-Chamas (1948). Cette espèce, assez commune, n'a pas été citée dans le Golfe de Marseille, où Marion signalait *P. belgica* (Bassin National avant 1882), mais elle existe dans la lagune de Venise (Vatova)²⁾.

Divers autres Annelides, qui n'auraient pu passer inaperçus s'ils avaient existé autrefois, sont particulièrement abondants de nos jours. En tout premier lieu, *Pomatoceros triquetus* (L), rencontré partout dans le Grand-Etang, fixé le plus souvent sur des coquilles de moules; d'autres Serpulides, indéterminés existent également.

Enfin *Mercierella enigmatica* Fauvel existe près de Port-de-Bouc, au Pont de Beaumasse, dans le canal d'Arles à Bouc. Cette espèce a également été rencontrée dans l'étang du Gajelon (B. du R.). Ces deux localités méditerranéennes sont donc à ajouter à la liste récemment publiée par P. Rémy³⁾.

Bryozoaires.

Scrupocellaria scruposa (L) et *Crisia denticulata* (Lmk), Etang de Caronte.

Crustacés.

Porcellana longicornis (Penn), Les Trois Frères, les parages de l'Arc (1947—1948).

Porcellana platycheles (Penn), Caronte, le Jai (1947—1948).

Dorippe lanata (L), Caronte (1947—1948).

¹⁾ Prenant, M. — "Etudes de bionomie intercotidale. La baie et la pointe de Quiberon." Trav. Stat. biol. Roscoff. f. 10, pp. 37—74 (1932).

²⁾ Vatova, A. — "Le zoocenosi della laguna veneta." *Thalassia* III, 10 (1940).

³⁾ Rémy, P. — *Bull. Mus. Hist. Nat.*, 2 s., XX, p. 532

¹⁾ Van Gaver et Timon-David. — "Etude sur la faune du canal de Marseille au Rhone entre l'Estaque et Port-de-Bouc." *Ann. Mus. Hist. Nat. Marseille*, XXVIII, 2 (1937).

Macropodia rostrata (L), Jai (1947—1948).
Portunus depurator (L), Jai, Figuerolles (1947—1948).
Eupagurus bernhardus (L), Jai (1947).
Idothea viridis Slabber (*I. salinarum* Dollfus), Jai (1947).
Zenobiana prismatica Risso, Jai, baie de St-Chamas (1948).
Microdeutopus anomalus Rathke, Tranchée de Gignac (1947).
Balanus sp. partout, sur les coquilles dans les fonds vaseux et très commun sur les rochers littoraux, aux Trois-Frères en particulier (1947—1949).

Tuniciers.

Styela plicata (Lesueur) *Clavelina lepadiformis* Müll.
Botryllus schlosseri Sv., Pont de Ferrières (1948).

En ce qui concerne les mollusques, diverses espèces d'introduction récente sont devenues assez fréquentes et assez largement réparties pour pouvoir être enregistrées comme établies dans l'étang: *Gibbula divaricata* (L), *Cantharidus striatus* (L), *Monodonta turbiformis* (Salis), *Monodonta stit* Récluz, *Cerithium mediterraneum* Brug, *Scala communis*

(Lmk), *Polynices alderi* (Forbes) var. *intermedia* Phil. sp., *Murex trunculus* L., *Ocenebra edwardsi* (Payr.), *Nassa pygmaea* (Lmk), *Acera bullata* Müll., *Aeolidiella glauca* Ald et Han, *Dentalium inaequicostatum* Dautz., *Nucula nucleus* (L), *Modiolaria marmorata* (Forbes), *Chlamys varia* (L), *Petricola lithophaga* (Retzius), *Macra corallina* L., *Spisula subtruncata* (D.C.), *Solen marginatus* Pult., *Ensis siliqua* (L). Une quinzaine d'autres espèces encore ont été rencontrées, mais qui doivent se trouver ici à la limite de leurs possibilités en matière d'euryhalinité et ne peuvent s'établir dans l'étang de façon définitive. Plusieurs espèces enfin ont élargi leur aire de répartition dans l'étang, particulièrement: *Lepidochiton cinereus* (L), *Patella caerulea* L., *Cerithium vulgatum* (Brug), *Ocenebra erinaceus* (L), *Philine aperta* (L), *Ostraea edulis* L., *Anomia ephippium* L. Les trois espèces suivantes, enfin, réputées complètement disparues de l'étang, s'y retrouvent à nouveau: *Chlamys glabra* (L)¹, *Modiolus adriaticus* (Lmk), *Venus gallina* (L).

Laboratoire pour l'Etude Biologique de la Camargue et des Etangs Méditerranéens (C.N.R.S.) Marseille.

¹) Petit, G. et Paulus, M. — "Sur la présence de *Chlamys glabra* à l'état vivant dans l'étang de Berre." Bull. Mus. Hist. Nat. Marseille, VII, P. 41 (1941).

Northern North Sea.

REVIEW.

DESPITE various difficulties in obtaining personnel, gear, and vessels, for investigations, the work in the Northern North Sea was intensified in 1948, although it was possible for only the Scottish vessels to maintain a general survey of the offshore waters throughout the year. It is greatly to be hoped that there will be an increase in facilities in 1949 which will make possible the intensive co-operation which all desire. Meanwhile, the most helpful assistance has been given by exchanges of material and information, by the organisation of returns of marked fish and drift-bottles, and in other ways.

No special investigations of fishing gear in this area have actually taken place during the year under review, although accounts of earlier work were presented to the Council in 1948, and investigations were resumed very early in 1949.

Several of the reports which follow are based on data collected by Scottish vessels, and it may be useful to those reading them if a brief note of their cruises is given.

The research vessel "Explorer" was in continuous commission from April to December inclusive and surveyed the following regions in these months:—

April:	North-western North Sea, and west Shetland waters.
May:	Faroe-Shetland Channel, north-western North Sea, and central North Sea.
June:	Northern North Sea between latitudes 57°30'N. and 59°30'N.
July:	Mid-Faroe-Shetland Channel, north-western North Sea and west Scottish waters to the Continental Edge.
August:	Orkney and Moray Firth waters, and area between Aberdeen and Bergen.
September:	Northern entrance to North Sea, and north-western North Sea.
October:	North-western North Sea (southern part) and central North Sea.
November:	North-western North Sea.
December:	Mid-east Scottish coast region.

From February 1948, the new herring research vessel "Clupea", operated in the Firth of Forth area until early April. From then until August "Clupea" worked off the mid-east Scottish coast and in the north-western North Sea.

Inshore investigations by the research vessel, "Kathleen" in 1948 proceeded in the Firth of Forth in February, the inner Moray Firth in May, the Orkney neighbourhood in July-August, the Moray Firth again in September, and the Firth of Forth in November.

At the end of the year the new research vessel "Scotia" (of 164 feet in length) was commissioned, and made a trial cruise in the waters to the west of Orkney.

A. Environment.

Hydrographical observations of temperature and salinity, together with surface drift-bottle results, show that the chief features of 1948 were not markedly dissimilar from those of 1947. Water movement through the Faroe-Shetland Channel during the spring, the normal time of maximum, was relatively weak, although probably stronger than in 1947. As usual, this movement decreased during the summer but, as in 1947, a second maximum developed in the autumn, only to decrease towards the end of the year. Striking features were the relatively small number of drift-bottles returned (about 20%) and the complete absence of British returns of drift-bottles to the south of latitude 57°30'N., whilst eastern North Sea returns were almost absent between April and September. In contrast, however, there were large numbers of such returns during the last four months of the year, even as far south as latitude 54°N.

Plankton data obtained from Continuous Plankton Records and the cruises of the "Explorer" showed the "mixed water" indicator *Sagitta elegans* to be relatively scarce in the North Sea, although *S. serrato-dentata*, *S. maxima* and *S. lyra* were commoner than in 1947. Of particular interest were the unusual

records of several exotic species, both in the North Sea and to the north-west, and the continued scarcity of salps.

B. The Fish.

Adequate records of eggs and young are still scanty in relation to the area to be investigated. In general the success of the 1948 spawnings seems to have been little better than in 1947, although scope-lids were abundant.

Haddock. Analysis of the "Explorer's" catches shows that the 1944-1945 year-classes were dominant, in some areas the catch being composed almost entirely of the 1945 group. In contrast the 1946 brood proved overall to be the poorest on record, whilst that for 1947 was well below average. Fortunately, there is some reason to hope that the current year brood may be rather stronger.

Finally, the commercial landings showed a distinct decline in all areas in the weight per 100 hours' fishing as compared with 1947, although the total weight obtained from the northern part of the area, due apparently to a greater growth rate, was greater than in 1947.

Lemon Sole. Catches of Lemon Sole by "Explorer" have been supplemented by sampling of the commercial landings. Whilst analysis of these is incomplete, the evidence so far suggests a distinct cessation of the decrease previously shown in the mean size, although the unit catch for the area was distinctly smaller than in 1947. Sixteen different year classes were obtained, of which that for 1939 was dominant.

Plaice. Regular observations of the inshore plaice stock of the east Scottish coast, with routine tagging, was continued by "Kathleen" in 1948, both for comparison with the pre-war conditions, and as a basis for the designing of new methods of investigation when staff is available. The influence of seine-netting in the Scottish inshore fisheries, in comparison with pre-war years, is being investigated.

Herring. The investigations of the Moray Firth herring fishery and the local plankton by the plank-

ton team at University College, Hull, which were begun in 1947, were continued in 1948. This same area was surveyed, along with those of the other herring fisheries off the east coast of Scotland, by the new research vessel "Clupea" from May to August. Moray Firth catches, on the whole, were rather poor in comparison with those of Shetland, partly perhaps due to poor recruitment, and partly due to adverse conditions (indicated by the presence of dog-fish, and perhaps by hydrographical conditions). The plankton investigations showed that spring-spawned herring larvae were extremely scarce in 1948.

A new method of herring "tagging" was introduced in the area towards the end of the season. Although only one tagged fish was recovered before the end of the fishing, more intensive and continuous tagging will be done throughout the 1949 season, in which the collaboration of other countries, by forwarding details of fish returned, will be gratefully accepted. Information was received very early in 1949 of other attempts to solve the problem of herring tagging.

The surveys of the catches of the Dutch herring luggers, which were first published in chart form for 1947, were continued in 1948, and form a valuable addition to our knowledge of the distribution of the herring. As a complement to these, arrangements were made in 1948 for detailed returns to be provided of the individual catches of herring by the drifter fleet off the north-east coast of Scotland in 1949.

Sprat. An investigation of the Norwegian sprat fishery is being initiated, particularly concerning the spawning places and their relation to the recruitment of the stock.

Mackerel. Records of the distribution and numbers of mackerel eggs were obtained over a wide area in 1948, and showed the principal concentration immediately to the west of the Norwegian Deep. Whilst the numbers of eggs could not usefully be compared with those in 1947, the corresponding production of larvae was distinctly smaller in 1948.

C. E. Lucas.

ENVIRONMENT.

Hydrography.

Scottish Investigations.

Continued limitation of facilities, although in lesser degree than in the previous year, restricted hydrographical work in 1948 to the observation of temperature and salinity distributions, and the liberation of surface drift-bottles. These operations, however, were carried out as intensively as circumstances allowed.

From all four Scottish research vessels, a grand total of over 3,500 combined temperature-salinity records was collected from surface, intermediate, and bottom sea levels, while from "Explorer", 1,445 surface drift-bottles were liberated in groups of five at 289 positions.

Reference may also be made to the commencement, in November 1948, of a continuous series of surface drift-bottle liberations from the position (Lat. 60°N. Long. 20°W.) occupied by one of the two British Weather Ships, and from five positions on longitudes 10°, 12°, 14°, 16° and 18°W., *en route* to the above position from the Firth of Clyde, at approximately three-weekly intervals. During November and December, 115 drifters were thus set afloat, and to the end of March 1949, four had been recovered, one in Orkney and three on the Norwegian coast. All four originated in the region of Rockall Bank.

The total drift-bottle return from the 1948 series, to the end of March 1949, was only 21 per cent., at least 10 per cent. below the average annual return. Part of the explanation is almost certainly due to a total lack of British east-coast recoveries south of about Buchan Ness on the Aberdeenshire coast, thus arguing, as a first approximation, a weak oceanic water incursion into the North Sea from the north throughout 1948.

It is material, however, before proceeding further with this survey, to recall the outstanding hydrographical features of 1947 in the North Sea and neighbourhood.¹⁾ Drift-bottle results for that year were invaluable in the interpretation of a remarkable constancy, at subnormal values on the whole, except at the surface, of the temperature and salinity distributions over almost the entire region north of the Dogger Bank throughout the late spring, summer, and early autumn. At the same time, and by contrast, large masses of oceanic water were banked up in the Faroe-Shetland Channel apparently by strong southerly-directed forces—probably emanating from the East Icelandic Arctic Current—which in effect sealed the mouth of the Channel between Faroe and Shetland and thus barred the progress north-eastward of the North Atlantic Drift Current.

The release of these forces towards the end of

September 1947, resulted in a strong impingement of waters all along the Norwegian coast and into the Skagerak in the months immediately following, especially in October. The effect subsided gradually in subsequent months almost to zero in January 1948, but further drift-bottle results, still from 1947 liberations, clearly demonstrate a marked revival of the same phenomenon in the month of March 1948. These results may be taken as evidence of the normal, comparatively rapid, spring increase in the intensity of the oceanic incursion through the Faroe-Shetland Channel into the northern North Sea. When, therefore, the 1948 open-sea investigations were begun in the month of April, this oceanic influx was probably at about its maximum seasonal intensity, or perhaps just beyond it.

The latter deduction, namely, of a waning incursion from the north after March 1948, is supported by the drift-bottle results for that year. Eastern North Sea (including Skagerak) recoveries ceased abruptly after April for more than four months, save for five singular records which show that such strandings were not entirely prevented during July and August by adverse currents in the immediate offshore vicinities. The numerous drifters set afloat in the North Sea from the Dogger Bank to latitude 61°N. during April, May and June, were evidently not carried into these offshore waters until considerably later as subsequent results reveal. This argues a relatively weak impulse southward into the northern North Sea from the north from about May to August at least, inclusive.

At the same time, however, especially in the months of June to August, recoveries were being notified in considerable numbers on the Shetland and Orkney Islands and in the Moray Firth. These derived principally from the April-May liberations in the north-western North Sea, and from certain parts of the Faroe-Shetland Channel region. That entry to the northern North Sea from the Faroe-Shetland Channel was mainly by way of the north of Shetland during April and May, and probably later, is clearly demonstrated by the Shetland returns from liberations north-west of Shetland out almost into mid-Channel, and from a position immediately north of Faroe. These recoveries link up with Orkney and Moray Firth strandings from liberations east, south-east, and south of Shetland, which in turn are associated with similar contemporaneous recoveries resulting from liberations distributed over the region south of the latitude of Fair Isle to the Moray Firth. Taken altogether they are indicative of circulatory water movement, or movements, embracing the north-western North Sea region from the Moray Firth to latitude 61°N. over the period from April to August inclusive. There is some

¹⁾ J. B. Tait: Scottish Hydrographical Investigations. *Annales Biologiques*, Vol. IV.

evidence also from drift-bottles of influx to the north-western region through the passages between Shetland and Orkney, chiefly between Fair Isle and Orkney, and it is apparent that this influx extended considerably to the eastward and south-eastward of Orkney, and well into the Moray Firth.

Continuing the broad deductions to be made from the drift-bottle results of 1948, their most prominent feature is a concentration of recoveries in the last quarter of the year and into 1949, with a pronounced maximum in October, on Skagerak and eastern North Sea shores from latitude 54°N . to latitude 61°N ., and representative of the liberations in all months from April to December. The southerly extension of these recoveries is noteworthy in two respects. Firstly, it is only in occasional years that strandings are recorded on eastern North Sea shores south of about latitude $56^{\circ}30'\text{N}$., and much more infrequently to the south of latitude $55^{\circ}30'\text{N}$. Secondly, these returns contrast markedly with the complete absence of recoveries in 1948 on the western side of the North Sea south of latitude $57^{\circ}30'\text{N}$.

The immediate argument which follows from this obvious impingement on eastern North Sea shores, is of a very pronounced accession to the intensity of the oceanic incursion southward into the northern North Sea from the Faroe-Shetland Channel. The inference is supported by the following circumstances:—

1. There is practically irrefutable evidence among the drift-bottle records concerned, of minimum drift-speeds in the northern North Sea of between 13 and 14 miles per day during at least the month of October. The actual figure was almost certainly greater and this, by the experience of former years, the records of which have been analysed in detail, is much more usually representative of spring or early summer velocities in those years in which the seasonal maximum in the oceanic influx is particularly strong.

2. Maximum numbers of eastern North Sea recoveries in October were followed by a maximum concentration in December of more northerly Norwegian recoveries outwith the North Sea, embracing the period from October 1948 to February 1949 inclusive, and again representative of all months' liberations from April to December.

Thus, it would appear from drift-bottle records alone that the oceanic influence which is normally the predominant factor in northern North Sea hydrography, attained its seasonal spring maximum in 1948 in the month of March. This maximum was not a particularly strong one, and accordingly waned fairly rapidly in the next two to three months, probably reaching its nadir between June and July. The same influence revived again slowly through August and early September and thereafter rapidly to a high maximum in October, again falling away somewhat to the end of the year.

Overall, the temperature and salinity distribu-

tions observed throughout the year support and amplify in details the foregoing deductions. Salinity was fairly high and constant at 35.35‰ to 35.39‰ along the 61°N . latitude in April, although Norwegian coastal water influence was manifest by reduction of both temperature and salinity in the uppermost waters east of longitude $1^{\circ}30'\text{E}$. Compared with the same section a year previously, however, it is clear that the spring oceanic incursion of 1948, although weak in comparison with a number of years, was stronger than that of 1947.

Salinity was only slightly less on latitude 60°N . than on latitude 61°N ., falling below 35.30‰ only within about twenty miles of the east coast of Shetland and again in the lowest water levels in the central part of the area between Shetland and longitude 2°E ., in the middle no doubt of the eddy system which drift-bottle results indicate to have been operative to the eastward of Shetland.

Upper water temperature anomaly in April exceeded $+1^{\circ}\text{C}$. north of about latitude $59^{\circ}45'\text{N}$., but was generally less than $+1^{\circ}\text{C}$., to the south of this latitude, and was associated with slight negative salinity anomaly in contrast with equally slight positive anomaly north of latitude $59^{\circ}45'\text{N}$.

Coastal water influence, doubtless from the west of Scotland, was evident in the salinity distribution around Orkney, to the north and north-west as well as eastward of the island group. There was, in fact, the usual differentiation between hydrographical conditions westward and eastward of the Shetland-Fair Isle line, but between Fair Isle and Orkney there was unmistakable evidence of more or less free flow of coastal or bank waters from west to east.

In the first half of May, the Faroe-Shetland Channel from the Wyville Thomson Ridge to the Faroe-Shetland line, was found to be entirely flooded in its upper layers with oceanic water of salinity in excess of 35.25‰ , and temperatures between 9°C and 9.5°C signified fairly intensive oceanic influence for the season.

Between the Butt of Lewis and the Faroe Bank, above the 400 metres level, salinity was almost everywhere greater than 35.35‰ , with a central core towards the southern end of this section of 35.40‰ to 35.50‰ salinity water.

Between Shetland and Faroe, on the other hand, maximum salinity in the main stream of the Atlantic Drift Current lay between 35.35‰ and 35.37‰ slightly lower, it should be observed, than the salinity on latitude 61°N . in April, thus signifying as between April and May, and as already deduced from drift-bottle records, the gradual waning of the spring maximum oceanic pulsation through the Faroe-Shetland Channel into the northern North Sea.

In the north-western North Sea in May, upper water temperature and salinity anomalies remained similar on the whole to those of April, with slight but irregular indications, due no doubt to eddy circulation, of more southerly extensions here and there of higher salinity water.

A survey of the central North Sea from the northern edge of the Dogger Bank to latitude 58°N . and eastward to longitude 4°E . was made in the last ten days of May. A marked negative salinity anomaly in the upper waters over the whole region, except in the Ling Bank-Fisher Bank area where normality prevailed, was the main feature of the observations, although surface temperature anomaly, as in the north-western area, was distinctly positive at over 1°C . Bottom water temperature, on the other hand, over the whole area, except at a position on the northern edge of the Dogger Bank where 5.89°C was recorded at 60 metres' depth, was fairly constant around the normal value of 7°C . A small thermocline of from about 1.5°C in the shallower, to nearly 3°C in the deeper waters was observed, situated between 10 and 20 metres near the land and deepening eastward to between 30 and 40 metres.

In the latter half of June, on two traverses of the northern area between Aberdeen and Stavanger and from Stavanger to Fair Isle, the influence of Baltic effluent was very marked in superficial layers east of longitude 3°E ., temperature-salinity distributions in conjunction with drift-bottle results in this area practically defining the limits of the eddy circulation frequently encountered therein. The bottom waters of the deep Norwegian rift were markedly oceanic in character, and appeared to be banked up near Stavanger. Around latitude $59^{\circ}30'\text{N}$, salinity was greater than 35.30‰ from about 80 metres to the bottom while only 30 miles farther south the 35.30‰ salinity surface lay at about 200 metres.

Evidence also for the functioning of the Great Eddy in the central part of the northern North Sea area is contained in the temperature-salinity distribution of June. By its agency Norwegian coastal water influence reached over almost to the prime meridian in the north-western North Sea, travelling northward around more saline water situated about midway between Fair Isle and Norway on latitude $59^{\circ}30'\text{N}$. The most concentrated oceanic water (salinity just over 35.30‰ and therefore declining from the April-May values) was found immediately east and south-east of Shetland.

A similar thermocline, scarcely more marked in degree compared with that encountered a month before in the central North Sea but lying somewhat deeper in the deeper regions of the northern area, was observed in the month of June.

Hydrographical operations in July were concentrated mainly to the north and west of Scotland. Mid Faroe-Shetland Channel salinities scarcely exceeding 35.40‰ , but mainly 35.35‰ to 35.40‰ in the upper waters to the north-west of Orkney, are suggestive of slightly less intensive oceanic influence than was observed over the Wyville Thomson Ridge in May. Temperatures scarcely above 11.5°C in mid-Channel support this deduction. Farther south, along the Continental Edge, there was further evidence in the salinity distribution, of diminished intensity as between May and July in the

north-easterly directed Atlantic Current. On the other hand, eastward penetration of oceanic water towards the lower west Scottish coast was a notable feature of the salinity distribution on the longitudinal section from Barra Head (at the southern extremity of the Outer Hebrides) to the north coast of Ireland, while coastal or bank water influence was appreciable in the uppermost 30-metre layer to 40 miles west of the Outer Hebrides.

The penetration of oceanic water, although much diluted, along the sea bottom well into the Moray Firth in August was a feature which is only occasionally observed at this season and was doubtless associated with the circulation which embraced the whole north-western North Sea area in that month. Oceanic characteristics also in the Buchan Deep area on latitude $57^{\circ}30'\text{N}$, gave first indication of the beginnings of an accession to the strength of the Atlantic water incursion from the north which increased in succeeding months. Oceanic water, in fact, centred on the prime meridian (salinity 35.25‰), completely filled the section of stations along a route from Buchan Deep to Bergen, out to longitude 2°E . Positive salinity anomaly, up to nearly 0.20‰ , was thus registered, although upper water temperatures associated with these salinities showed, at 12.20°C to 13.36°C , appreciable negative anomaly, indicating that the oceanic influence in the northern North Sea was scarcely past the nadir of the waning phase recorded in successive months since March 1948. East of longitude 2°E ., to Bergen, Norwegian coastal water influence was increasingly evident in the superficial water layer.

The thermocline observed two months before was, in August, entirely absent from the Buchan Deep area, but appeared, still in relatively small degree ($<3^{\circ}\text{C}$) as compared with former years, between 40 and 60 metres to the east of the prime meridian.

In the first week of September a complete section of twelve equidistant stations from Norway to the north of Shetland was run along latitude $61^{\circ}01'\text{N}$. Fresher water influence from the eastern side of the North Sea was considerable in the uppermost waters of the section as far westward as the prime meridian. On the other hand, as compared with the same section between longitudes 1°W . and $2^{\circ}30'\text{E}$., five months previously, (just after the period of the maximal spring Atlantic water influx into the northern North Sea), the salinity from 40 metres' depth to the bottom in considerably over 100 metres was markedly greater in September, exceeding 35.40‰ over a wide area of the section. Upper water temperatures of from 12.25°C to over 13°C also, with the distinct positive anomaly of about 1°C for the season, support the deduction of increasing oceanic influence from a minimum some one or two months before. Further data from the north-western North Sea in the latter part of September give added weight to these observations.

Positive salinity anomaly up to at least 0.20‰ , associated with positive temperature anomaly to

nearly 1°C, had extended southward and prevailed over a wide area of the central North Sea by the middle of October. The bottom water of the Great Fisher Bank was distinctly oceanic and dilution over a wide area from the bank was relatively small. Bottom water temperature scarcely fell below 7.5°C and for the most part was higher, even at depths greater than 70-80 metres.

November operations in the north-western North Sea showed a slight decline in both temperature and salinity anomalies from those recorded in October in the same area and farther south. Both remained positive, except in a small area immediately south of latitude 60°N, in the centre of the northern region. This small area, as other indications also suggest, probably lay within the northern boundary of the Great Northern Eddy of the North Sea, which moreover, by this position (south of latitude 60°N.) still further enhances the deduction of maximal autumnal intensity of the oceanic impulse into the region. 35.35 ‰ salinity water (but none of 35.40 ‰ salinity as in September) was still present on the latitude of 61°N., and indeed for at least 30 miles to the southward. Temperatures above 9.5°C also, although approaching normality for the season,

were still approximately 0.5°C above the average. Oceanic water (35.00 ‰ to 35.13 ‰) was still present south of latitude 58°N. in the north-western area.

The tendency to decline which was noticeable in the temperature-salinity data for November in the north-western North Sea was perhaps more appreciable in December in the eastern part of the central North Sea, although observations to the north-west of Orkney in the latter half of the month tend to maintain the conception of an abnormally strong Atlantic Current through the Faroe-Shetland Channel over the autumn-winter period of 1948.

Thus for the second successive year it would appear that, while clearly differing in degree, the Atlantic water transport through the Faroe-Shetland Channel into the northern North Sea was relatively weak at the period of its spring maximum intensity, weaker in 1947 than in 1948, but that on the other hand, the less frequent phenomenon on the whole of autumnal maximum intensity manifested itself almost exactly at the same period in both years, and was probably also stronger in 1948 than one year before.

John B. Tait.

Plankton.

Some Broad Changes in the Plankton round the North of the British Isles in 1948.

Introduction.

The Continuous Plankton Recorder Survey, as operated by University College, Hull, from various ports in the British Isles, affords particular opportunity for tracing, month by month, or year by year, the changes of the sub-surface plankton in the North Sea and adjacent waters. Inherent in the method is the ability to obtain more widespread and regular samples than is possible with the conventional plankton net hauls from research ships. This has encouraged us to prepare a broad summary of the plankton which can be presented in the *Annales Biologiques* each year so long as the programme is continued.

A general account of the plankton in 1947 was published in 1948¹⁾, and gave at the same time, some comparison with earlier years. It is felt that it would now be wiser to provide numerical data so that successive comparisons may be made more easily over a long term. Detail will be avoided intentionally. The object rather is to demonstrate major phenological changes and trends in the environment of the fish populations. Full reports and

considered comment on the Recorder results are published, from time to time, in the *Hull Bulletins of Marine Ecology* but, of necessity, there is the delay between obtaining the facts and presenting the conclusions. However, observations of the type now offered can more easily be kept up to date and so provide contemporary information in a standard form which may suggest to other workers any parallel trends which are developing.

The routes on which data were usually obtained each month in 1948 are shown in Figure 1, and the plankton in each case has been analysed in some detail.²⁾ The five routes marked by the heavier line have been selected for the present summaries, i.e. W, X, V, A and K.

These summaries take the general form of the average numbers of certain organisms per theoretical unit volume³⁾ of water sampled along the line of tow. There is, however, a sharp and consistent boundary both in the quantity and the quality of the plankton on the three lines running into the deeper Atlantic waters (W, X and V) which is usually found over the 200 fathom contour. So for

²⁾ Details of the composition of the plankton on any particular route or routes can be made available by the Department of Oceanography, University College, Hull, England.

³⁾ The volume as calculated from the sampling aperture of the Recorder and the unit distance towed, i.e. 10 miles.

¹⁾ Ann. Biol. IV, pp. 63-66.

each of these three records two figures may be presented, one for that part of the line on the coastal side of the 200 fathom contour, and one for the seaward side. The series starts in November, 1947, when information from the more southerly Atlantic route first became available.

There is one limitation to this method that must always be kept in mind when considering the results. The plankton is sampled at one depth only, 10 metres, and so the data may not give a fair estimate of those organisms which have a differential depth distribution or carry out diurnal vertical migrations.

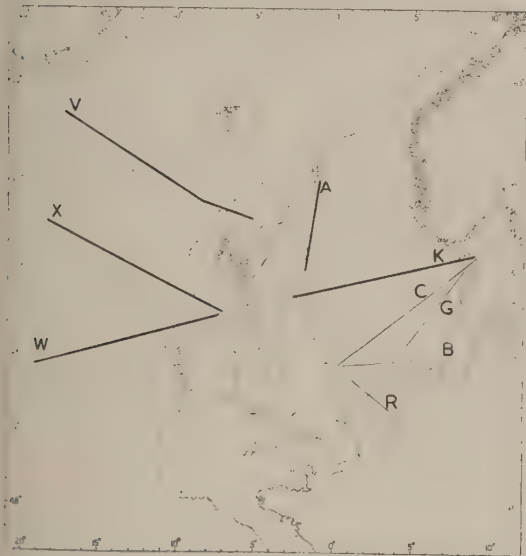


Fig. 1. A chart showing the routes along which the Continuous Plankton Recorder was usually towed monthly in 1948. The routes indicated by the heavier line, i.e. W, X, V, A and K are those selected for this summary. The dotted line marks the position of the 200 fathom contour.

The method of sampling has, however, the advantage of being continuous and so overcomes the errors due to horizontal patchiness which may be effective when isolated samples are taken at intervals in space.

Phytoplankton.

It is difficult to make any fair assessment of "Total Phytoplankton". No method is entirely satisfactory and our technique precludes any volumetric or chlorophyll extraction estimation. Cell counts are available for a number of the larger species but the size range makes any attempt to sum these extremely complicated. If one realises their limitations, prob-

ably the best data available for the present purpose are colour appreciations which are made for each Recorder roll as soon as it reaches the laboratory. Each two inches of sampling silk, which is equivalent to approximately five miles of tow, is graded into one of four colour categories by comparing it with a standard. The range runs from "no green" to "dark green" and as greenness is the only criterion, it may be considered as a very coarse estimation of total chlorophyll content. There is, of course, a considerable personal element of error, aggravated by the varying tones of green and the presence of varying quantities of other coloured plankton, which may make it difficult to match the intensity of colour with the standard series. But it is the practice for two workers to make independent assessments and disagreement is not common.

Figure 2 shows the percentage of the records taken on each line in each month that fell in the various green categories, and so gives a broad indication of the amount of plant life present. The black represents dark green, the hatching green, and the open histograms pale green and very pale green.

These results can have little significance until similar series are available in subsequent years for comparison; no finite values, however approximate, can be given to them. Nevertheless, they show points of interest. In the North Sea, the K line gave the form we expect, the dense spring flowering in March and April followed by the summer decline and a second outburst in September. On the A line there was a similar trend, although the extent of the phytoplankton was less. In the Atlantic, lines W and X, the spring crop did not appear until May, two months later than that in the North Sea. It is unfortunate that we cannot time the outburst on the V line owing to the absence of data in March and April, and the missing October record prevents us from knowing whether an autumn crop occurred on the W line, as it did on the others. It is significant that over the coastal end of the X line, i.e. that part inside the 200 fathom contour (not illustrated), the sequence was similar to the North Sea, K line, in that the spring maximum appeared in April, the autumn one in October and a minimum was reached in June.

The detailed specific composition of the phytoplankton is beyond the scope of this report. *Thalassiothrix longissima* was a major constituent in the Atlantic water but did not appear this year in the North Sea records. *Rhizosolenia alata* was common throughout in the autumn, but *var. genuina*, found in the North Sea, gave way to *var. indica* in the Atlantic with a mixture of the two on the V line. *Thalassiosira* spp. were prominent in the spring in the North Sea. *R. hebetata* *var. semispina* was generally present, while the varieties of *R. styliformis*, which is a predominantly autumn form in the southern North Sea, were more abundant in the spring than the autumn in the Atlantic.

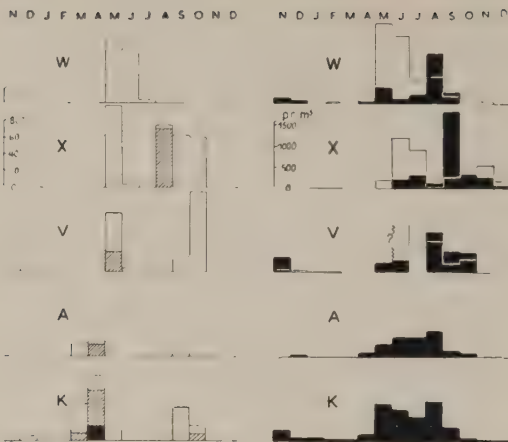


Fig. 2. An estimate of the density of *Phytoplankton* month by month on the Recorder routes W, X, V, A and K. The histograms show the percentages of the routes which sampled water containing various quantities of phytoplankton as estimated on a colour scale — see text, p. 57. The result for August on the X line is misleading as this is the one case in which the colour was caused almost entirely by large numbers of unusually green dinoflagellates.

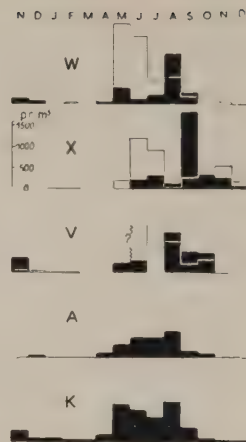


Fig. 3. Histograms representing the relative numbers of *Total Copepoda* (all species combined) taken month by month on the Recorder lines W, X, V, A and K. The values represent the number of copepoda per cu. metre either for the whole length of tow on routes A and K or for the two parts of the tow which lie on either side of the 200 fathom contour on routes W, X and V (the solid histogram shows the numbers over the deeper water and the open histogram over the shallower or coastal water.)

Total Copepoda.

In Figure 3 the average numbers of copepods per cubic metre are shown. All species are summed and no correction has been made for size. Generally speaking it was during the summer months, from May to October, that the copepod population flourished but there were marked differences between the Atlantic waters and the North Sea. Over the deeper Atlantic waters, W and X (solid histograms), August and September were clearly the maximal months, whereas in the North Sea, A and K, the season was more evenly spread and there is little difference between May, June, July and August. Past experience has led us to expect maximal numbers in May or June on the North Sea records.¹⁾

There was a marked contrast between inshore and offshore waters in the Atlantic and again the coastal conditions approximated more to those in the North Sea; the unshaded histograms show that to the shallower side of the 200 fathom contour the spring was far more productive than the autumn. Future years may show whether the late spring pro-

duction of phytoplankton and the weak spring copepod population are a regular feature in deeper Atlantic waters, and result from some common cause or mutual relationship.

Calanus. These data are included in the series because it is believed that *Calanus* plays a particularly important part in the ecology of the feeding herring round the coast. The "large *Calanus*" illustrated in Figure 4 are those which are readily visible to the unaided eye and may be taken to comprise the copepodid stage V and adults at 10 m. depth. The scale adopted is so much greater than the one used for the total Copepoda that, although the *Calanus* are included in the total Copepod figures, they do not influence the previous histograms to any considerable extent. There was again a marked difference between the Atlantic water and the North Sea, but the relationship was reversed. The maximal period for "large *Calanus*" became progressively later as one moved from the Atlantic round into the North Sea. However, closer agreement between the coastal waters in the Atlantic and the North Sea is again noticeable.

In Figure 5 all the copepodid stages of *Calanus* are combined and a comparison of the scales used in Figures 4 and 5 make it plain how few individuals approach maturity; in fact, Figure 5 can be considered to reflect closely the numbers of *Calanus* younger than the fifth copepodid stage. There are interesting differences and similarities between the numbers of "large" and young. On the three Atlantic lines over the deeper water, the two categories showed parallel trends but in the North Sea the young were proportionally far more successful in the early part of the

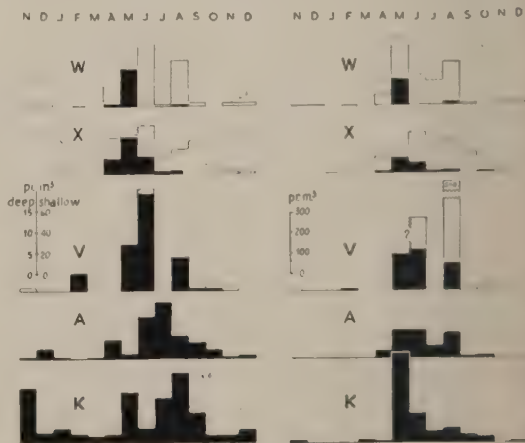


Fig. 4. Histograms representing the relative numbers of *Large Calanus* (copepodid stages V and VI) taken month by month on the Recorder lines, W, X, V, A and K. Details as in Fig. 3.

Fig. 5. Histograms representing the relative numbers of *Calanus* (all stages combined) taken month by month on the Recorder lines W, X, V, A and K. Details as in Fig. 3.

¹⁾ Hull Bull. Mar. Ecol. I, No. 4 and II, No. 11.

year than the "large". One might at first sight be tempted to identify the dense population of young found on the K line in May with the generation that gave rise to the increasing numbers of Stage V and VI which culminated in August but past work¹⁾ would suggest that such a period would cover two breeding cycles. During this period intensive sampling of the plankton of the area of the north-east coast of Scotland was carried out by the herring fleet using Hardy Plankton Indicators and the daily information on the density of *Calanus* so obtained showed a steady but rapid decrease in the population from the end of May which coincided with a great increase in the number of herring taken in the nets.

Other Copepoda. Four other species of Copepoda are included as Figures 6—9. These species have been selected from all those found as it is believed that each has a value as an "indicator". *Pleuromamma robusta* (6) appears as an Atlantic winter form; it was most common on the W route and was not found in the North Sea. *Euchaeta norvegica* (7) appeared only over deep water, only occurring on the Recorder routes in the North Sea over the deep water at the Skagerak end of the K route, it has a more northerly distribution in the Atlantic than *P. robusta*. Except for small numbers taken on the W route in the winter, *Candacia armata* (8) was restricted to the "mixed" water in the Northern North Sea. *Metridia lucens* (9) was generally present.

¹⁾ Hull Bull. Mar. Ecol. II, No. 14.

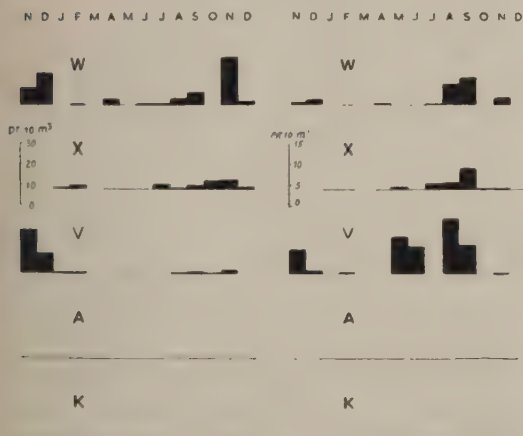


Fig. 6. Histograms representing the relative numbers of *Pleuromamma robusta* taken month by month on the Recorder routes W, X, V, A and K. Only that part of the tow taken outside the 200 fathom contour is included on routes W, X and V.

Fig. 7. Histograms representing the relative numbers of *Euchaeta norvegica* taken month by month on the Recorder routes W, X, V, A and K. Only that part of the tow taken outside the 200 fathom contour is included on routes W, X and V.

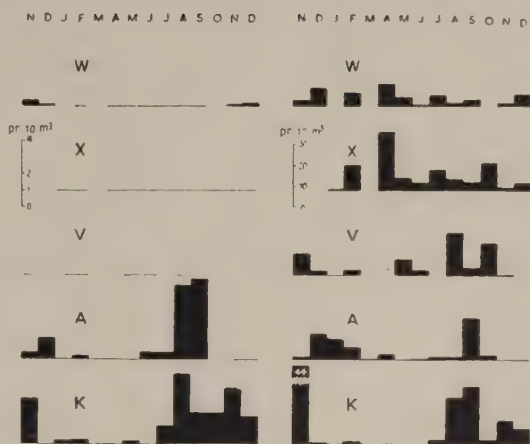


Fig. 8. Histograms representing the relative numbers of *Candacia armata* taken month by month on the Recorder routes W, X, V, A and K. Only that part of the tow taken outside the 200 fathom contour is included on routes W, X and V.

Fig. 9. Histograms representing the relative numbers of *Metridia lucens* taken month by month on the Recorder routes W, X, V, A and K. Only that part of the tow taken outside the 200 fathom contour is included on routes W, X and V.

C. armata and *M. lucens* were amongst the forms which have been found in earlier years to spread into the North Sea in the autumn and winter²⁾. The present data show, however, that in 1948 their distributions were by no means identical.

Pteropods. Figures 10 and 11 give the average numbers of various pteropods on the five routes. Only the larger individuals of *Limacina retroversa* (10) are included, i.e., those measuring more than 1 mm. across. Both *L. retroversa* and *Clione limacina* (11) show the tendency for the month of maximum numbers to be later as one moves northwards in the Atlantic and then round to the North Sea.

Tomopteris. Tomopteris is included as Figure 12. A detailed study of its distribution shows it to be a form which may prove to be typical of a number of species which prosper in the Atlantic for a short season, appear to move into the North Sea later and then survive there for the major part of the season.

Sagitta. Only those Sagittae over 1 cm. in length are included in Figure 13, which shows the boundaries of the distribution of the various species. On the Atlantic routes was found *S. serratodentata* which gave way to *S. elegans* in the mixed water of the Northern North Sea. The K route crossed the well-known boundary of the *S. elegans*—*S. setosa* populations in the North Sea. *S. maxima* accompanied by *Eukrohnia hamata* occurred in the north-western

²⁾ Hull Bull. Mar. Ecol. II, No. 11.

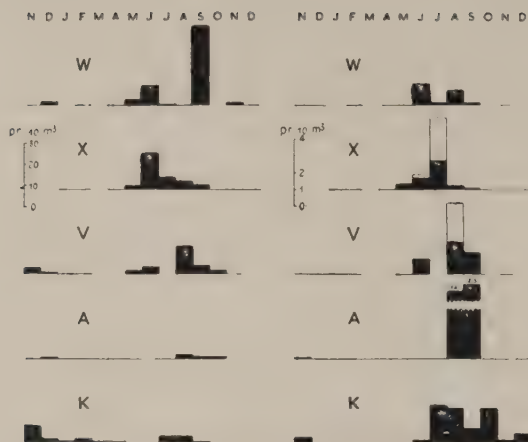


Fig. 10. Histograms representing the relative numbers of *Limacina retroversa* (only those individuals larger than 1 mm. included) taken month by month on the Recorder routes W, X, V, A and K. Only that part of the tow taken outside the 200 fathom contour is included on routes W, X and V.

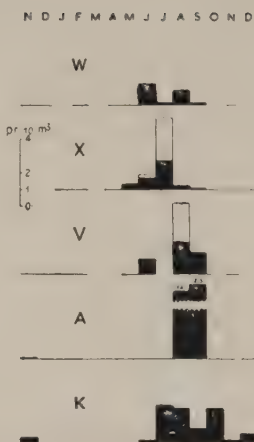


Fig. 11. Histograms representing the relative numbers of *Clione limacina* (solid) and *Clio* spp. (open line) taken month by month on the Recorder routes W, X, V, A and K. Only that part of the tow taken outside the 200 fathom contour is included on routes W, X and V.

part of the area sampled in May and June. The south-eastern boundary of this population was sharply defined giving way to the warmer water species, *S. serratodentata* (together with the copepod *Rhincalanus nasutus*), some 250 miles south east of the Iceland coast. In the inshore waters to the coastal side of the 200 fathom contour along the Atlantic lines, W and X, *S. elegans* was again dominant, so providing another example of the similarity between the plankton of this water and the North Sea.

General. It is not easy to assess 1948 in terms of the "indicator species" usually associated with water movement from the Atlantic into, or towards, the North Sea. Thaliacea were not common, only a few doliolids being taken on the X line in June and on the W line in July. None were found as far north as the V line but there was no record in July, the month in which they are usually most abundant in that region. Amongst the euphausiids, *Nematoscelis megalops* did not repeat its previous appearances on the A route in the early months of the year, but then its occurrence in the Atlantic water sampled was only spasmodic. *Thysanoessa longicaudata* also failed to be recorded in the North Sea, although it

was widespread in the Atlantic. On the other hand, the occurrence of *S. maxima* on the A route in June and of *S. serratodentata* on the K route in August and September, when compared with previous Recorder results, suggest unusual Atlantic influence in the North Sea.

It is hoped that it will be possible next year to provide a comparable series of histograms showing the fluctuations in fish eggs and the young fish population, grouped into the major categories, clupeids, gadoids and pleuronectids, with some species recorded in detail. The data are not yet available but they will then be shown retrospectively to November 1947, to cover the period of the present report. Other "indicator species", such as the euphausiids, will also be included in the future, together with any other forms which may prove to be of interest.

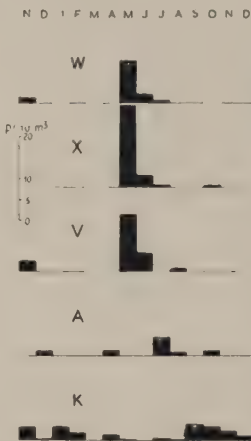


Fig. 12. Histograms representing the relative numbers of *Tomopteris* taken month by month on the Recorder routes W, X, V, A and K. Only that part of the tow taken outside the 200 fathom contour is included on routes W, X and V.

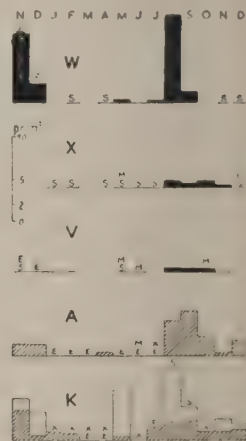


Fig. 13. Histograms representing the relative numbers of *Sagitta* (only those individuals longer than 1 cm. included) taken month by month on the Recorder routes W, X, V, A and K. The specific composition of the total is indicated by shading, black for *S. serratodentata*, hatching for *S. elegans* and white for *S. setosa*; presence in numbers too small to be shown on the scale is indicated by the letters S for *S. serratodentata*, M for *S. maxima*, E for *S. elegans* and X for *S. setosa*. Only that part of the tow taken outside the 200 fathom contour is included on routes W, X and V.

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University College, Hull.

Plankton Distribution in Scottish and Adjacent Waters in 1948.

Plankton collections on which this report is based were taken by the Scottish research vessel "Explorer" from April to December 1948, and by the "Scotia" in December.

April investigations in the northern North Sea showed the phytoplankton distribution to be patchy. Green collections were taken east of Pentland and east of Shetland where *Rhizosolenia hebetata* f. *semispina*, and *Chaetoceros decipiens* dominated, with *Rh. shrubsolei*, *Rh. styliformis*, *Ch. densus* and *Ch. convolutus*. The dinoflagellates were mainly *Ceratium tripos* and *C. horridum*, but *C. reticulatum* was also present. Hensen net collections were of moderate volume except in the Moray Firth and west of Fair Isle where they were poor. East of Fair Isle the volumes were mostly between 6 and 20 ccs. per 100 metres vertical haul, but one collection off Aberdeen contained more than 50 ccs. Collections were mostly of small copepods (*Pseudocalanus* and *Acartia*) and larval forms, particularly *Balanus nauplii*. Early developmental stages of *Anomalocera* were found in the Moray Firth. *Sagitta setosa* was generally distributed in the area and extended north to 60°N. *S. elegans* was only poorly represented in April 1948.

By May, *Halosphaera* was abundant enough to be noticed by naked eye examination of even some of the larger mesh collections in the northern North Sea area, particularly east of Fair Isle. *Thalassiosira gravida* and *T. condensata* had become dominant amongst the diatoms. Some green collections contained unidentifiable green masses, probably faecal pellets with chloroplasts of flagellates, when diatoms and dinoflagellates were scarce. The densities of Hensen net collections were similar to those of April in these areas. In the Faroe-Shetland Channel volumes were generally up to 30 ccs.—consisting mostly of stage V *Calanus finmarchicus*, but they were very low on the southern area of the traverse between Faroe and the Butt of Lewis, and to the north of Faroe. Moderately rich collections were taken from the east side of the central North Sea.

Sagitta elegans, though generally present throughout its normal area of distribution, was rarely recorded as greater than "few" in number. *Eukrohnna hamata*, *Calanus hyperboreus* and *Metridia longa* were found together between Faroe and Shetland though not in the immediate neighbourhood of Faroe. *S. serratodentata* was found north of the Butt of Lewis and north of Flugga, i.e., only on the Scottish ends of the Faroe Channel traverses. As in 1947, it was present north of Orkney, east of Pentland and east of the Moray Firth, but in 1948 it was also present east and west of Shetland and along the line of the stations at 61°N. to at least 2°E. *Calanus finmarchicus* was not generally abundant except in the Faroe-Shetland Channel where it was found with

Euchaeta norvegica, *Meganyctiphanes norvegica* and *Thysanoessa longicaudata*. Decapod larvae, especially early larvae of *Pandalus* and *Hyas*, were generally distributed in the Orkney-Shetland and Faroe region, but not in the Faroe Channel. A concentration of *Evadne nordmanni* was found east of Fair Isle.

June samples were taken from the northern North Sea. *S. elegans* was still fairly scarce but present off the east Scottish coast, and *S. setosa* was common on the eastern side of the north to central North Sea where *Anomalocera* was also fairly common. *Cyanea* was recorded as present only from the eastern side, but *Cosmetira* and *Turris* were found north-east of Aberdeen with *Amphinema* and *Sagitta serratodentata*. *Physophora* and *Euchaeta norvegica* were found in the Norwegian Deep.

The July collections, particularly those taken in deep water west of Scotland, were perhaps the most interesting of the year, though the actual volume of material taken in the Hensen net was small except where medusae were abundant. Decapod larvae, especially *Eupagurus* larvae, were very abundant off the north coast, but were less common or very scarce in the deeper and more truly oceanic water, being represented there by a few larvae of *Portunus*, *Sergestes* and *Discias atlanticus*. *Meganyctiphanes norvegica* and *Thysanoessa longicaudata* were present but not in great numbers. These oceanic collections were rich in exotic species, including *Lensia conoidea*, *Chelophyes appendiculata*, *Galettia australis*, *Dimophyes arctica*, *Agalmopsis elegans*, *Hippodius*, *Physophora*, *Clio pyramidata*, *Diatria trispinosa*, *Pneumodermopsis ciliata*, *Tracheloteuthis riisei*, *Sagitta maxima*, *S. lyra*, *S. serratodentata*, *Eukrohnna hamata*, *Philomedes brenda*, *Euchirella rostrata*, *Rhincalanus*, *Eucalanus* and *Doliolletta genbaueri*. *Aglantha digitalis* was only abundant at the outer stations. At five stations, viz:— 59°10'N. 7°45'W.; 58°40'N. 8°35'W.; 57°23'N. 9°35'W.; 56°50'N. 9°50'W.; and 56°50'N. 9°30'W.; collections were made beyond the 200 fathom line, and the following species were also taken from one or more of these stations:— *Nausithoe punctata*, *Eirene viridula*, *Rhopalonema velatum*, *Sagitta planctonis*, *Krohnitta subtilis*, *Peracリス triacantha*, *Euchirella curticaudata*, *E. messinensis*, *E. truncata*, *Arietellus plumifer*, *Chirundina streetsi*, *Pareuchaeta gracilis*, *Undeuchaeta major*, *Centraugaptilus rattrayi*, *Heterostylites longicornis*, *Scottocalanus securifrons*, *Pleuromamma xiphias*, *Heterorhabdus spinifrons*, *Brachycelus cruscum*, *Scina crassicornis*, *S. rattrayi*, *Nematoscelis megalops*, *Stylocheiron longicornis*, *S. elongatum*, *Euphausia krohnii*, and larvae of the fish *Argyrolepis hemigymnus*, and *Bathylagus benedicti*.

Krohnitta (Eukrohnna) subtilis (Grassi) is here recorded for the first time from Scottish waters. The occurrence of *Euchirella truncata* Esterly = *E. intermedia* With, from off the west coast is also of special interest.

For at least three years in succession, salps have been scarce or absent in Scottish waters, and in 1948

only a single specimen of a disintegrating *Ihlela asymmetrica* was found—at 57°23'N. 9°35'W.

Diatoms were still plentiful off the west coast in July, the main species being *Rhizosolenia shrubsolei*, *R. semispina*, *Stephanopixis*, *Chaetoceros* spp. and *Eucampia*. A short excursion into the Faroe Channel showed that the fauna there had increased considerably since May and contained many oceanic forms similar to those from off the west coast (see the NW. area report). Off the north coast of Scotland disintegrating *Cosmetira* were very abundant, and *Aurelia* was abundant in the Moray Firth. *Obelia* medusae were still present in coastal areas.

August collections off the north coast and in the Moray Firth confirmed the July investigations on the whole but showed also an increase in the numbers of *Aurelia* in the Moray Firth.

The September sampling was confined to the northern North Sea. On the line of 61°N. between Shetland and Norway the volumes from the Hensen net were poor east of 2°E. and rich west of that point; *Meganyctiphanes*, *Thysanoessa longicaudata*, *Clio pyramidata*, *Limacina retroversa*, *Pneumodermopsis* and *Pleuromamma robusta* were found chiefly east of 1°E.; *Sagitta elegans*, and *Rhincalanus* were most common west of 2°E. and *Sagitta setosa* mainly east of that line. Thus there appears to have been an area of mixing at 61°N. between 1°E. and 2°E. *Calanus* was not present in great numbers in the northern North Sea in September and the medusoid fauna was small, though *Laodicea* was found off the Norwegian coast and east of Shetland. *Physophora* and *Chelophyes* were present in small numbers throughout the northern area and a few specimens of *Doliolletta gegenbauri* were found off the east coast of Shetland.

Investigations during the autumn were made in the north central North Sea in October and the coastal and northern areas in November and December. Hensen net volumes were rather poor in the Moray Firth and off the east coast generally (usually less than 5 ccs. per 100 m. vertical haul.) *Thysanoessa raschii* and *Nyctiphanes couchii* were the dominant euphausiids, the former being especially abundant in the Firth of Forth, and the latter more abundant in the Moray Firth and northern area generally. *Thysanoessa inermis* was also present, but in smaller numbers. *S. setosa* continued to be abundant in the central North Sea and *S. elegans* in coastal areas. The influx of oceanic species into the area could still be traced. *D. gegenbauri* was present north of Orkney, east of Fair Isle, east of Pentland and off the Angus coast (56°30'N.). *Rhincalanus* was found east of Orkney and Fair Isle, in the Moray Firth and off Kinnaird Head; *Lensia conoidea* east of Orkney and the Pentland Firth, and *S. serratodentata* north, south and west of Orkney and as far south as the Firth of Forth on the east Scottish coast. Perhaps the most astonishing records of the year were taken in the Moray Firth on 1st December, when a specimen of *Sagitta lyra* and one of *Aequ-*

orea forskalea were taken at the same station. As far as is known, neither of these has ever been previously recorded from the Moray Firth. *S. lyra* is an oceanic form which rarely penetrates into the North Sea though species were found east of Shetland in 1946 and it was found off the west coast of Scotland in 1939, 1946, 1947 and 1948; and this is the first specimen of *Aequorea forskalea* to be taken by the Scottish research vessels in recent years.

The "Scotia" made a short trip to the north-west of Orkney in December. Oceanic plankton at that time contained patches of abundant *Meganyctiphanes norvegica* and *Anchialus agilis* with *Euphausia krohnii*, *Thysanoessa longicaudata*, *Nyctiphanes couchii*, *Primno macropus*, *Sagitta lyra*, *S. hexaptera*, *S. serratodentata*, *Lensia conoidea* and *Chelophyes appendiculata*. There seems little doubt that the oceanic species in the Moray Firth were linked up with this fauna via the north of Orkney, a linkage which has been previously suggested from planktonic as well as from other evidence.

J. H. Fraser. A. Saville.

List of Rare Exotic Species found in the Plankton by the Scottish Vessel "Explorer" in 1948.

This list excludes commonly occurring exotic species even although they may be of very great value as "indicators", it also excludes species occurring rarely in 1948 but which have been found commonly in other years. Species marked * were not recorded in 1947.

	Position		Date
	N. Lat.	E. Long.	
Siphonophora			
<i>Dimophyes arctica</i> *	61°01'	1°00'	11.4
		W. Long	
	60°08'	5°32'	11.7
	60°15'	6°00'	11.7
	59°10'	7°45'	16.7
	56°50'	9°50'	18.7
<i>Galettia australis</i>	59°32'	0°43'	18.4
	59°44'	7°15'	3.5
	62°16'	7°32'	5.5
	59°10'	7°45'	16.7
	58°40'	8°35'	16.7
<i>Lensia conoidea</i>	60°08'	5°32'	11.7
	60°15'	6°00'	11.7
	59°10'	7°45'	16.7
	58°40'	8°35'	16.7
	58°12'	9°15'	16.7
	57°23'	9°35'	17.7
	56°50'	9°50'	17.7
	56°50'	9°30'	18.7
	56°50'	9°02'	18.7
	56°50'	8°34'	18.7
	59°25'	2°34'	27.7
	58°35'	1°14'	3.11

	Position		Date		Position		Date
	N. Lat.	W. Long.			N. Lat.	W. Long.	
<i>Lensia conoidea</i>	58°56'	1°42'	7.11	Ostracoda:			
	59°42'	1°17'	7.11	<i>Conchoecia haddoni</i> *	60°08'	5°32'	11.7
	59°32'	3°04'	20.12		60°15'	6°00'	11.7
	60°00'	4°49'	20.12		56°50'	9°50'	17.7
<i>Hippopodius hippopus</i> *	58°12'	9°15'	16.7	<i>Conchoecia daphnoides</i>	60°15'	6°00'	11.7
	59°42'	1°17'	7.11		56°50'	9°50'	17.7
Medusae:					56°50'	9°30'	18.7
<i>Halopsis ocellata</i>	60°15'	6°00'	11.7	<i>Conchoecia borealis</i> *	57°23'	9°35'	17.7
<i>Nausithoe punctata</i> *	58°40'	8°35'	16.7	Amphipoda:			
	57°23'	9°35'	17.7	<i>Brachyscelus cruscum</i>	57°23'	9°35'	17.7
	56°50'	9°50'	17.7	<i>Hyperiodes longipes</i> *	57°23'	9°35'	17.7
<i>Rhopalonema velatum</i> *	57°23'	9°35'	17.7		56°50'	9°50'	17.7
	56°50'	9°30'	18.7	<i>Scina rattrayi</i> *	56°50'	9°50'	17.7
	60°00'	4°49'	20.12	<i>Scina crassicornis</i> *	56°50'	9°50'	17.7
<i>Aequorea forskalea</i> *	57°51'	3°08'	1.12	<i>Primno macropus</i>	59°47'	4°03'	20.12
Polychaeta:					59°54'	4°32'	20.12
<i>Vanadis formosa</i> *	56°50'	9°50'	17.7	Euphausiacea:			
Chaetognatha				<i>Euphausia krohnii</i> *	57°23'	9°35'	17.7
<i>Sagitta planctonis</i> *	58°40'	8°35'	16.7		60°00'	4°49'	20.12
	57°23'	9°35'	17.7	<i>Stylocheiron longicorne</i>	57°23'	9°35'	17.7
	56°50'	9°50'	17.7		56°50'	9°50'	17.7
<i>Sagitta hexaptera</i> *	60°00'	4°49'	20.12		60°00'	4°49'	20.12
<i>Krohnitta subtilis</i> *	56°50'	9°50'	17.7	<i>Stylocheiron elongatum</i>	56°50'	9°50'	17.7
Copepoda:				<i>Nematoscelis megalops</i>	56°50'	9°50'	17.7
<i>Euchirella curticauda</i>	59°10'	7°45'	16.7	Decapod Larvae:			
	56°50'	9°50'	17.7	<i>Discias atlanticus</i> *	60°08'	5°32'	11.7
	56°50'	9°30'	18.7		58°40'	8°35'	16.7
<i>Euchirella truncata</i> *	57°23'	9°35'	17.7		56°50'	9°50'	17.7
	56°50'	9°50'	17.7		56°50'	9°30'	18.7
<i>Euchirella messinensis</i> *	56°50'	9°50'	17.7	Pteropoda:			
<i>Heterostylites longicornis</i> *	60°15'	6°00'	11.7	<i>Clio cuspidata</i>	59°31'	7°05'	3.5
	59°10'	7°45'	16.7		60°15'	6°00'	11.5
	57°23'	9°35'	17.7	<i>Pneumodermopsis ciliata</i>	60°08'	5°32'	11.7
	56°50'	9°50'	17.7		60°15'	6°00'	11.7
<i>Scottocalanus securifrons</i>	59°10'	7°45'	16.7		59°10'	7°45'	16.7
	56°50'	9°50'	17.7		58°40'	8°35'	16.7
<i>Centraugaptilus rattrayi</i> *	57°23'	9°35'	17.7		57°23'	9°35'	17.7
	56°50'	9°50'	17.7		56°50'	9°30'	18.7
<i>Heterorhabdus spinifrons</i> *	57°23'	9°35'	17.7		61°01'	3°30'	5.9
<i>Arietellus plumifer</i> *	56°50'	9°50'	17.7		E. Long.		
<i>Chirundina streetsi</i> *	56°50'	9°50'	17.7		61°01'	1°30'	6.9
	56°50'	9°30'	18.7		61°01'	1°00'	6.9
<i>Pleuromamma xiphias</i>	56°50'	9°50'	17.7		W. Long.		
<i>Euchaeta hebes</i> *	59°54'	4°32'	20.12	<i>Diacria trispinosa</i>	59°10'	7°45'	16.7
<i>Pareuchaeta glacialis</i> *	59°10'	7°45'	16.7		58°40'	8°35'	16.7
	56°50'	9°30'	18.7		57°23'	9°35'	17.7
<i>Pareuchaeta gracilis</i> *	56°50'	9°50'	17.7		56°50'	9°50'	17.7
					56°50'	9°30'	18.7
<i>Undeuchaeta major</i>	56°50'	9°50'	17.7		E. Long.		
					60°44'	1°46'	30.9

	Position		Date
	N. Lat.	W. Long.	
<i>Peraclis triacantha</i> *	56°50'	9°50'	17.7
Tunicata:			
<i>Oikopleura vanhoffeni</i>	61°09'	7°24'	4.5
<i>Ihleia asymmetrica</i> *	57°23'	9°35'	17.7

The following species recorded in 1947 and included in the list of exotics in *Annales Biologiques* Vol. IV. were not found in 1948:— *Corina granulosa*, *Augaptilus megalaurus*, *Phaenna spinifera*, *Calanus gracilis*, *Undeuchaeta plumosa*, *Haploptilus*

	Position		Date
	N. Lat.	W. Long.	
Fish Larvae:			
<i>Bathylagus benedicti</i>	59°10'	7°45'	16.7
	56°50'	9°50'	17.7
<i>Argyropelecus hemigymnus</i>	56°50'	9°50'	17.7
<i>Fierasfer</i> spp.	59°21'	5°28'	12.7
	61°01'	0°48'	9.9

validus, *Conchoecia obtusata*, *Conchoecia elegans*, *Nansenia groenlandica*, *Paralepis borealis*, *Stomias* box.

J. H. Fraser. A. Saville.

THE FISH.

Eggs and Larvae.

Annual Brood Values of Fish Larvae.

The brood values of the larval fish taken by the Scottish research vessel "Explorer" in 1948 have again been assessed as described in *Annales Biologiques* Vol. IV, in which the comparative figures for 1938, 1939, 1946 and 1947 are given.

On the whole, fish larvae were, apparently, a little more abundant in 1948 than in 1947, but were still well below the values of 1938 and 1939. The assessment figures show that the larval haddock brood was considerably bigger than in 1947 but was still small. The low value in June/July/August indicates that in 1948 the spawning was early in the year as it was in 1938 and 1946 rather than later as in 1939 and 1947. Cod, *Gadus minutus* + *G. esmarkii*, witch and sand-eels all had poor larval broods, but plaice larvae were more numerous in the Scottish records than in 1947 and dabs again had a good brood year. In contrast to the other years for which data have been published, dabs were more abundant in the records of June/July/August than in those of the preceding three months. Scopelids, mostly *Myctophum glaciale*, were considerably more numerous in the records of 1948 than in previous years for which comparative data are available. The brood values of other fish were about average.

Spring spawned clupeoid larvae were extremely scarce in the 1948 records, the brood assessment being only a quarter of that for 1947, which was itself a poor year. Numbers per station were highest north of Shetland in April and at about 60 miles N.E. of the Firth of Forth in May. The autumn spawned larvae would also appear to have been scarce in comparison with 1938 and 1939, though comparable in numbers with 1947. Fairly high figures were recorded from stations west of Orkney

Table 1. Comparative Brood Assessment Values for Larval Fish for 1948.

Species	March/April /May	June/July /Aug.	Sept./Oct. /Nov.
<i>Gadus callarias</i>	1.61	—	—
<i>G. aeglefinus</i>	7.16	0.04	—
<i>G. virens</i>	25.56	—	—
<i>G. merlangus</i>	6.02	3.96	0.01
<i>G. minutus</i>	6.91	0.27	—
<i>G. esmarkii</i>			
<i>G. poutassou</i>	0.04	—	—
Merluccius	—	0.45	0.18
<i>Molva</i> spp.	0.17	0.80	0.06
<i>Onos</i> spp.	3.03	3.28	3.01
Other gadoids	0.22	0.25	0.01
<i>Pleuronectes platessa</i>	2.04	—	—
<i>P. limanda</i>	1.71	7.17	0.26
<i>P. cynoglossus</i>	0.04	0.99	0.29
<i>P. microcephalus</i>	0.34	2.07	2.24
Other flat fish	1.71	1.80	0.09
Clupeidae	11.32	3.65	60.11
<i>Trigla</i> spp.	0.52	0.86	0.29
<i>Ammodytes</i> spp.	7.45	12.83	0.41
<i>Gobius</i> spp.	0.11	3.51	7.59
<i>Fierasfer</i> spp.	—	0.01	0.03
Scopelidae	0.04	13.02	0.14
Other fish	4.00	7.87	2.62

in August and off the Firth of Forth in October and December.

Mackerel Larvae.

The cruises of the "Explorer" in May and June to the northern and central North Sea and across the Norwegian Deep were suitably placed to traverse the main spawning areas of mackerel, though the extent of the area could not be assessed. Samples

were taken by towing a stramin net, 1 metre in diameter, at the surface for $\frac{1}{4}$ hour at about 2 knots. The greatest concentrations were found in June to the immediate west of the Norwegian Deep where the depth was rather less than 200 metres. Here concentrations of 4,000 to over 30,000 eggs per haul were taken. Hauls of 100, 1000, 3000 and 4000 were taken over the deep water and a single collection to the east of the deep water had 8000. Hauls in the northern North Sea generally were much smaller and had generally less than 500 eggs, though a few hauls of up to 2000 were taken in the "Gut". In coastal regions there were generally less than 100 eggs per haul but up to 200 or 1000 were taken at stations at the edge of the deep water of the Faroe Channel, north of the Butt of Lewis.

Mackerel larvae were found in smaller numbers only from May to August. The numbers of larvae were so few compared with the numbers of eggs, that it seems likely that the absence of sampling at the edge of the Norwegian Deep in July has given a distorted impression of scarcity. The larvae found were at the edge of the deep water of the Faroe Channel in May and July and generally distributed in the Orkney—Shetland region and off the east Scottish coast in August. Though not present at the edge of the continental shelf off the west coast of Scotland in July, a few were found between the Scottish and Irish coasts, north of the Irish Sea.

The numbers of larvae found in 1948 were considerably less than in 1947 which was an exceptional good brood year for mackerel (see Ann. Biolog. Vol. IV.). It is not possible to compare mackerel egg production in the two years as no cruise into the appropriate area was made in 1947 until too late in the year.

Sebastes Larvae.

Larvae of *Sebastes viviparus* were taken in similar sites to those of mackerel except that the distribution tended to be more northerly and westerly. Though present in the Norwegian Deep in June, they were not found in the remainder of the North Sea samples except east of Shetland and Fair Isle. They were, however, taken at most of the stations off the north coast of Scotland and west of the Hebrides, where a few larvae of *S. marinus* were also found.

J. H. Fraser. A. Saville.

Haddock.

North Sea Stocks in 1948.

The age and size compositions of the North Sea haddock stocks in 1948 have been determined, as in previous years¹), from data collected by the research vessel "Explorer" during the course of trawling surveys carried out between April and December. During this period data were collected from the

main haddock grounds of the central and northern areas and also from the Moray Firth, the Firth of Forth and areas to the west of the Shetlands, the Orkneys and the Scottish mainland.

Sampling was effected by means of the covered otter trawl, one-hour hauls being made at scattered points throughout the sampling area. Apart from a preliminary choice of the region to be sampled each month, the positions at which trawling was carried out were selected at random from the trawlable grounds, so that an unbiased estimate of the stock strength within each part of the North Sea should be obtained. Thus, the average catch per unit fishing time calculated for each area from these data do not represent the peak shoal densities, as is more often the case with the results of commercial catches, but they indicate the areas of greatest overall haddock abundance, and by comparison with the results of previous years show the annual fluctuations and trends in the abundance of both the marketable and recruitment broods.

The data from the 1948 survey have been considered for six areas separately, the limits of which and the statistical squares which they comprise, are given below.

Area	Statistical Squares
Northern.	D—H. 18—21 (including C18 b and d.)
North Central.	C—J. 14—17 (including B15 b and d.)
Central.	C—J. 14—17
Moray Firth and East Orkney.	A14, 15. B14, 15 a and c. 16 and 17.
Firth of Forth and Coastal Areas.	A11, B10, 11 and 12.
Western Area.	All grounds west of the above.

Thus, the main body of the North Sea has been divided into three regions; the northern, including the grounds eastwards from the Shetlands, the north central, those to the east of the Orkneys and Moray Firth, and the central, those between the Scottish and Danish coasts, but excluding the inshore grounds off the Scottish east coast. The first two areas comprise the main spawning area of adult haddock and support the main haddock fishery in the spring and summer months whilst the third is the shallower area which receives the extension of the southward feeding migration in the autumn. The west Shetland and west Orkney grounds have been grouped together with those off the north and west coasts of Scotland, whilst the inshore grounds to the east of the Orkneys are included in the Moray Firth.

In accordance with the methods used in earlier investigations, the abundance of each age-group is expressed as the number per 10 hours fishing. Although this, as a measure of average brood strength, is subject to bias from occasional extreme values, it

¹) Parrish, B. B. Ann. Biolog., Vol. IV, (1947). 1948.

Table 2. Age Composition of Haddock caught by F.R.V. "Explorer" in 1948 per 10 hours trawling.

a) Northern Area					b) North Central Area				
Month:	April— June	July— Sept.	Oct.— Dec.	All Months	April— June	July— Sept.	Oct.— Dec.	All Months	Age
Hours trawling:	21	10	9*	40	35	15	12	62	
Year-Class									
1947	243	490	268	310	109	295	145	161	1+
1946	20	64	21	32	21	29	16	22	2+
1945	665	907	715	737	511	515	415	498	3+
1944	101	112	68	96	68	41	54	59	4+
1943	17	21	7	16	6	2	8	5	5+
1942	}	6	17	11	2	1	8	3	6+
1938									10+
All Ages	1058	1600	1096	1202	717	902	646	748	
c) Central Area					d) Moray Firth				
Hours trawling:	13		14	27	2*	6*	12	20	
1947	227	No Sampling	187	206	30	223	24	84	1+
1946	21		6	13	20	8	0	5	2+
1945	174		139	155	385	445	162	269	3+
1944	38		24	31	140	82	50	67	4+
1943	2		1	2	15	10	6	8	5+
1942	}		0	1	10	6	0	3	6+
1938									10+
All Ages	463		357	408	585	774	242	436	
e) Firth of Forth and Coastal Areas					f) Western Area				
Hours trawling:	1*		6*	7*	10.	15	3*	28	
1947	0	No Sampling	7	6	12	1	0	5	1+
1946	0		0	0	5	5	10	6	2+
1945	40		12	16	375	571	323	474	3+
1944	50		3	10	149	203	37	166	4+
1943	30		0	4	33	52	27	42	5+
1942	}		0	7	12	21	3	16	6+
1938									10+
All Ages	170		22	43	586	853	400	709	

* Not truly representative figures.

is considered to be sufficiently representative of the overall population density for differences in the abundance and distribution of the constituent age-groups to be revealed.

Age Composition.

The results of the age analysis made from scale samples collected in each area during the year are presented in Table 2. It gives the frequencies per 10 hours for each age-group except the 0+ brood for the quarterly periods April—June, July—September and October—December and for the whole sampling period. The catches of fish older than five years of age are recorded as one group because of

the small numbers involved. It will be observed that in some periods the intensity of sampling in any one area was less than 10 hauls, in which cases, the abundance of the age broods may not be truly representative of the population in the whole area. The respective columns are headed by asterisks. The results of this analysis show that the trawl catches over the whole area contained fish ranging between one and ten years of age. Of these, the two youngest broods were mostly below the minimum marketable size limit of 11 inches (see later) throughout the greater part of the North Sea and constituted the upgrowing recruitment broods, whereas the broods older than two years comprised the commercially exploitable stock.

The age frequencies of the marketable sizes show that the haddock fishery during 1948 was based mainly on the broods spawned in 1945 and 1944. In the principal trawling areas of the north, north-central and central areas the broods constituted approximately 98 per cent of the total stock, with the 1945 brood approximately eight times the more numerous. The greatest density of the 1945 brood was in the deep waters of the northern area, where the catch per 10 hours was significantly higher than in the shallow central area. The 1944 brood, on the other hand, was most densely populated in the western area, especially on the west Orkney grounds, but as with the 1945 brood, the deep waters yielded greater numbers of this brood than those to the south of the 100-metre contour.

The broods older than four years of age were also caught in greatest numbers in the northern waters, but their numbers were small over the whole of the North Sea.

Table 3. Distribution and Density of the 1948 Brood in "Explorer" Catches August—December, 1948.

Area	No. of Fish	No. of Hours	No. p. 10 hrs.
Northern Area	1445	17	850.0
North Central Area	1194	27	442.2
Central Area	491	14	350.7
Moray Firth and E. Orkney Area	627	17	368.8
F. of Forth and Coastal Areas	231	6	(385.0)
Western Area	4	5	(8.0)
Total for All Areas	3992	86	464.2

Recruitment.

The numerical strength of the upgrowing 1946 and 1947 broods was found, from this survey, to be less than that of the 1945 brood over the whole of the North Sea. The 1946 brood was caught in very small numbers in all areas, and, as in the previous year's survey, proved the poorest recruitment brood on record. The 1947 brood, although numerically superior to the 1946 one was caught in much smaller numbers than the 1945 and 1944 ones at the same age, and when compared with the broods caught during the inter-war period, was below the average abundance level for one-year-old fish. The largest numbers were caught in the northern area, where some dense concentrations were located, but recruitment was particularly poor in the Firth of Forth and western areas and only local shoals were encountered on the Moray Firth grounds.

The 0+ brood, resulting from the 1948 spawning concentrations, first appeared in the research vessel's catches in August and figured in the data collected for the remainder of the year. Although the esti-

mates of abundance obtained for it during this period may not represent its true recruitment value on account of its pelagic behaviour, they do indicate the centres of greatest density, and give some measure of its relative abundance.

The number caught, the number of hours fishing and the catch per 10 hours for this brood have been calculated for each of the six areas for the period August—December and are presented in Table 3.

These preliminary results show that, despite wide fluctuations in numbers of fish caught from adjacent hauls, the numerical strength of this brood during its first year of life was greater than either the 1947 or 1946 broods at the same age. Dense shoals were located at widely scattered points throughout the sampling area, but the greatest overall density was found in the northern areas, especially towards its eastern extremity.

Size Composition and Growth.

The sizes of the age-groups present in the catches from each area have been determined from the length measurement data taken at sea. The range of lengths and the mean length for each of the five youngest broods has been determined in quarterly periods for the six areas and are given in Table 4.

The mean lengths of all the age-groups considered in Table 4 were greater in the catches from the central area than in those from the north, the difference in mean length being particularly marked for the 1945 and 1944 broods. In the central area the majority of the 1945 brood were above the minimum marketable size during the whole of the sampling period, whereas in the deep water areas many of its members were below this size during the early part of the year. In the central region also, most of the 1946 brood had reached marketable size by the last quarter of the year, whereas on the northern grounds only the largest of this brood were of marketable size.

It is apparent therefore that a greater proportion of the haddock population in the central area was available for commercial exploitation, so that the difference in weight yield from these areas would be less than is given by a comparison of the age frequencies presented in Table 2, a—c. A measure of the difference has been obtained by calculating the weight per 10 hours for each area from the length frequency distributions of fish of marketable size, and the average weight of haddock at each centimetre length, these figures being taken from data published by Russell¹⁾. These results are given in Table 5 for the periods April—June and October—December.

These figures show that the northern and north central areas averaged approximately 55 % and

¹⁾ Russell, E. S. Report on Market Measurements in relation to the English haddock Fishery during the years 1909—1911. Fish. Invest., Ser. II, Vol. I, Pt. 1, 1914.

Table 4. Mean Lengths of Haddock from each

Year Class	Age	Months	Northern Area			North Central Area			Central Area		
			No. of Fish	Range (cm.)	Mean Length (cm.)	No. of Fish	Range (cm.)	Mean Length (cm.)	No. of Fish	Range (cm.)	Mean Length (cm.)
1948	0+	July-Sep.	1217	8—16	12.7	1072	7—18	12.2	—	—	—
		Oct.-Dec.	228	12—18	14.8	122	11—19	15.5	491	10—24	14.2
1947	1+	Apr.-June	511	13—24	18.3	381	15—25	20.8	295	18—28	22.1
		July-Sep.	490	20—28	24.1	442	20—29	23.6	—	—	—
		Oct.-Dec.	241	22—28	24.5	174	23—32	26.2	262	22—39	29.1
1946	2+	Apr.-June	43	21—28	24.3	73	22—31	25.7	26	26—32	28.1
		July-Sep.	64	24—32	28.0	43	25—30	27.0	—	—	—
		Oct.-Dec.	19	26—29	27.1	19	26—34	30.6	9	28—36	33.1
1945	3+	Apr.-June	1396	22—45	28.2	1788	23—44	28.9	225	25—44	32.1
		July-Sep.	907	26—42	30.1	803	25—41	30.0	—	—	—
		Oct.-Dec.	644	25—41	30.2	498	26—49	31.7	194	32—48	38.1
1944	4+	Apr.-June	213	30—49	35.8	260	29—50	34.7	50	33—48	41.1
		July-Sep.	112	32—47	37.4	61	30—43	35.0	—	—	—
		Oct.-Dec.	61	31—43	36.9	65	30—54	37.6	33	38—55	45.1
1943	5+	Apr.-June	35	35—59	42.9	21	36—49	42.0	3	44—52	47.1
		July-Sep.	21	40—54	43.8	3	36—45	42.0	—	—	—
		Oct.-Dec.	6	40—46	42.7	9	38—56	45.2	2	48—49	48.1

25% greater weights of marketable fish respectively than the central area. The increase in yield in all areas between the second and last quarter of the year can be attributed mainly to the growth of the 1945 brood during the year, but in the central area fewer recruits entered the fishable stock than in the regions of slower growth to the north.

The Commercial Trawl Fishery.

As in 1947, the landings of haddock by British trawlers have been considered separately for three regions of the North Sea, these corresponding to the combined north and north-central areas and the central area, referred to in this report, and the grounds to the south of latitude 55°N., which were not extensively sampled in the research vessel survey. The total landings, the hours fishing and the landing per 100 hours are given for each of these areas in quarterly periods in Table 6.

The total weight of haddock landed from all regions of the North Sea by British trawlers was approximately 7,000 tons less in 1948 than in 1947, whilst the fishing effort was 91,000 hours greater. The decrease in the landings was most marked in the central and southern regions the total yields and yields per 100 hours showed a marked decline over the high levels reached during the autumn of 1947. In the northern area the total landing increased over the previous year's level, but the yield per 100 hours was less in each quarterly period. These figures, therefore, indicate a decline in the weight densities of haddock from the 1947 level in all parts of the North Sea.

Summary.

The marketable haddock stocks in the North Sea during 1948 were shown by the research vessel survey to be composed principally of fish spawned in 1945 and 1944, these broods making up approximately 98 per cent of the total stock on the principal haddock trawling grounds. Catches were greater in all months from the northern region than from the

Table 5. Numbers and Weight of Marketable Haddock caught by "Explorer" in North Sea in 1948.

Area	April—June		Oct.—Dec.	
	Number p. 10 Hrs.	Weight p. 10 Hrs. (cwt.)	Number p. 10 Hrs.	Weight p. 10 Hrs. (cwt.)
Northern	449	2.81	739	4.12
North Central	406	2.11	540	3.69
Central	227	1.81	327	2.69

shallower waters to the south, but in this region growth was faster, giving a greater yield per fish.

Recruitment, as measured by the abundance of the 1946 and 1947 broods in the research vessel's catches was of a low order. The 1946 brood was poorly represented in the catches from all areas, and the 1947 brood was found only in locally dense concentrations to the east of the Shetlands. The 1948 brood, in its first year of life, was caught in greater numbers than either of the two older broods, particularly in the northern area.

The total yield of haddock from the North Sea

Group from North Sea in 1948.

Moray Firth			Firth of Forth			Western Area			Year Class	Age	Months
Range (cm.)	Mean Length (cm.)	No. of Fish	Range (cm.)	Mean Length (cm.)	No. of Fish	Range (cm.)	Mean Length (cm.)				
6—18	12.8	—	—	—	4	7—12	9.5	1948	0+	July-Sep. Oct.-Dec.	
13—24	18.8	231	14—22	17.3	—	—	—				
20—23	20.9	—	—	—	12	15—22	19.8	1947	1+	Apr.-June July-Sep. Oct.-Dec.	
21—31	25.6	—	—	—	2	23—25	24.0				
26—31	26.5	4	32—33	32.2	—	—	—	1946	2+	Apr.-June July-Sep. Oct.-Dec.	
23—25	23.8	—	—	—	5	25—32	27.0				
24—34	27.6	—	—	—	8	22—34	26.0				
—	—	—	—	—	3	29—32	30.3				
25—43	34.7	4	33—40	36.7	375	25—44	30.9	1945	3+	Apr.-June July-Sep. Oct.-Dec.	
26—41	33.1	—	—	—	856	25—41	31.5				
29—49	38.8	7	38—51	43.1	97	28—43	34.6	1944	4+	Apr.-June July-Sep. Oct.-Dec.	
32—51	40.1	5	43—54	47.2	149	29—45	37.7				
33—48	38.7	—	—	—	304	31—46	37.4				
34—58	43.8	2	46—56	51.0	11	31—47	36.5				
44—45	44.7	3	45—51	47.7	33	36—49	44.0	1943	5+	Apr.-June July-Sep. Oct.-Dec.	
37—54	41.7	—	—	—	78	36—51	42.0				
41—52	47.4	—	—	—	8	44—52	47.8				

by commercial trawlers was approximately 7,000 tons less than in 1947 despite a nine per cent. increase in the fishing effort, and the yield per 100

hours also showed a marked decline in each of the main North Sea regions for each quarterly period.

B. B. Parrish.

Table 6. Landings of Haddock by British Trawlers from North Sea Regions in 1948.

Date	N. of Lat. 57°30'N.			Lat. 55°N. to 57°30'N.			South of Lat. 55°N.			All Areas*		
	Weight landed, in 100 cwts.	100 hrs. fishing	Weight landed p. 100 hrs. (cwts.)	Weight landed, in 100 cwts.	100 hrs. fishing	Weight landed p. 100 hrs. (cwts.)	Weight landed, in 100 cwts.	100 hrs. fishing	Weight landed p. 100 hrs. (cwts.)	Weight landed, in 100 cwts.	100 hrs. fishing	Weight landed p. 100 hrs. (cwts.)
Jan.-March	943	611	154	179	211	85	20	1830	1	1382	2819	49
April-June	749	708	106	208	438	47	48	1307	4	1351	2684	50
July-Sept.	179	336	53	1025	928	110	204	1314	15	1607	2820	57
Oct.-Dec.	1161	752	154	872	626	139	140	1565	9	2556	3316	77
Total:	3032	2407	126	2285	2203	104	412	6016	7	6896	11639	59

* Includes landings from unknown rectangles.

Flat Fishes.

Flat Fishes in Scottish Waters - 1948.

General.

In last year's report it was noted that the catches of lemon soles by the research vessel "Explorer" had fallen to a very low level as compared with pre-war years. During 1948 the grounds covered by the vessel were approximately the same as during 1947, and in 190 one-hour hauls with the otter trawl the total catches of lemon soles, megrims and witches

were 446, 641 and 403 fish, respectively, giving figures of 23, 34 and 21 per 10 hours' fishing. Compared with the corresponding figures for 1947, viz., 14, 24 and 10 these averages per unit of fishing time show a marked improvement but they are still much below the figures for the immediate pre-war years. These post-war records, however, cannot be entirely regarded as indicating scarcity of flat-fishes as there is evidence that the "Explorer's" trawl is better designed for catching round fish than flat fish — a matter which is under examination. It is interesting to note that, although the numbers of turbot

taken by the research vessels in the North Sea are small, the average figure for this species during the post-war years is higher than that of the pre-war period.

Lemon Soles.

In addition to the 446 lemon soles taken by the "Explorer" 295 specimens were caught by the "Kathleen", mainly in territorial waters of the Scottish east coast, and principally from the Moray Firth and Aberdeen Bay. It is clear that such small numbers are insufficient for a study of the composition of the lemon sole stocks. Sampling of the species from trawler catches landed at Aberdeen has, therefore, been continued throughout the year. Forty-eight samples, comprising measurements and scales from about 3600 fish, were collected from North Sea catches. Owing to pressure of work, however, it has been impossible, so far, to examine all these samples although those taken up to mid-July have been dealt with. Details of the size and age of all North Sea lemon soles examined during the year are given in Tables 7 and 8. Fish retained in the small mesh covering the cod-end are included in the research vessel's records.

The size composition of the "Explorer" records from the more southerly grounds resemble those of the commercial vessels from the same area (S. of Rattray Head) in that the majority of the fish taken are from 31—40 cm. in length, i.e., fish mainly falling into the medium and large categories of pre-war days. As may be expected from a knowledge of the growth rates of the species, higher proportions of small fish were taken by the "Explorer" north of 58°30'N. The "Kathleen" records also show higher proportions of small fish, but this may be due to other causes.

Table 7. Size Composition of Lemon Sole Catches 1948 (to mid-July).
(per mille).

Size-Group in cm.	Explorer	Kathleen	Aberdeen Trawlers		
	S. of 58°30'N.	N. of 58°30'N. & West C.	Territorial Waters	S. of Rattray Hd., Jan. to July	E. of Moray Firth, Jan. to July
< 16	8	81	85	—	—
16—20	31	129	200	—	—
21—25	146	156	281	39	60
26—30	200	258	234	146	242
31—35	288	242	153	281	389
36—40	238	118	44	389	236
41—45	81	16	3	142	73
46—50	8	—	—	3	—
Total Catch:	260	186	295	1368	450

Table 8. Age Analysis of Lemon Sole Catches 1948. (per mille).

Brood	"Explorer"	"Kathleen"	Aberdeen Trawlers		
	N. Sea S. of 58°30'N.	N. Sea N. of 58°30'N. and West C.	Territorial Waters N. Sea	N. Sea S. of Rattray Head Jan. to July	N. Sea E. of Moray Firth Jan. to May
1947	—	—	7	—	—
1946	19	16	78	—	—
1945	128	130	363	9	4
1944	132	157	197	59	56
1943	163	124	210	163	220
1942	70	65	24	70	118
1941	120	195	44	122	142
1940	54	92	10	67	60
1939	182	87	54	202	173
1938	43	43	3	97	64
1937	27	38	3	86	60
1936	46	33	7	100	71
1935	12	5	—	15	16
1934	—	5	—	9	9
1933	4	5	—	1	7
1932	—	5	—	—	—
Total number investigated:	258	185	295	1363	450

Comparing the commercial samples for 1947 with those for the first seven months of 1948, little change in the size composition of the fish can be observed. This is interesting since each year since 1945 has shown a marked fall in the average size of lemon soles taken. Further examination of the remaining samples for 1948 may, however, modify the results so far obtained.

As regards the age analysis, the commercial catches were made up of 13 different year-classes from 3 to 15 years of age, and those of the research vessels of 16 different broods from 1 to 16 years of age. The most outstanding individual brood, on the chief lemon sole grounds S. of 58°30'N., both numerically and also by weight, was that of 1939. In the commercial catches this brood contributed one fifth of the total number of lemon soles — the majority of these being large fish of 35 to 45 cm. Next in importance came the 1943 brood represented almost entirely by small fish. The 1941 brood also contributed substantially to the catch by numbers, especially on more northerly grounds. The once excellent 1936 brood, now much reduced, continued to show up well and to outnumber those of 1937 and 1938. By reason of their size, the fish of these three broods together undoubtedly outweigh even the contribution by the prolific 1939 brood.

From January to July the commercial catch of lemon soles per 100 hours fishing was 1478 fish in

1947 and 951 fish in 1948. This represents a decrease of 35.6 % and is borne out by trawl skippers who, throughout 1948 have found the species scarcer than at any time since the end of the war.

B. B. Rae.

Herring.

Continued Observations on the Herring Concentration on the Fladen Ground, the Gut, and Environment, 1948.

1. Fishing Grounds and Landings.

As in the preceding years the herring concentrations in the northern area of the North Sea were again actively trawled by Belgian fishermen. The grounds worked by them during the period July to October are situated between 55° to 58°30' N. Lat. and between 0°30'W. and 2°E. Long. (see the accompanying chart). 62 trawlers were attached to this fishery. The average duration of a voyage is calculated to 11.5 days, or 8 days effective fishing.

2. Biological Statistics.

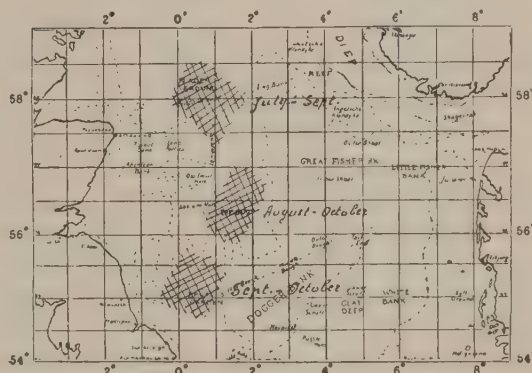
The material has been collected during the period August to October. It includes 18 series of 50 herrings each, i.e. a total of 1,000 herrings, 400 for August, 400 for September and 200 for October.

As in 1946 and 1947, the results have been divided in monthly periods, so as to observe the variations which might occur in the composition of the herring concentrations.

The various biological characters of each stage of maturity have again been examined, i.e., the total number of vertebrae, the number of prehaemal vertebrae, and the number of keeled scales. The results confirm once more the presence of two well-

Monthly Landings of Herring.

	Number of landings	Weight landed Total (tons)	Average catch for one landing for one fishing day per 1 developed H.P. (kg)
July	22	403	18
August	79	2,259	33
September	101	6,074	60
October	52	3,040	58
Total	254	12,104	48



Fishing grounds exploited by Belgian herring trawlers during July–October 1948.

defined groups: one group including herring in maturity stage I to IV, the spawning of which will probably not take place before the beginning of 1949, and a second group including the herring of maturity stages V to VIII-II, i.e., herrings in full reproduction or very near maturity.

Size Distribution (Measurement to the millimeter).

Period	cm. 22	23	24	25	26	27	28	29	30	31	Mean	Weight. g. Mean
August	0.5	—	0.5	6.2	16.8	40.8	28.2	6.8	0.2	—	27.5	165
September	0.2	—	0.2	4.0	18.2	37.5	30.5	8.8	—	0.5	27.6	159
October	3.0	8.5	7.0	19.0	25.0	28.5	7.5	1.5	—	—	26.2	134
Total	0.9	1.7	1.7	7.9	19.0	37.0	25.0	6.5	0.1	0.2	27.3	157

Sex

Maturity Stages (Percentage Distribution).

Period	Male o/o	I	II	III	IV	V	VI	VII	VIII-II
August	53.7	0.5	4.8	10.8	23.5	49.2	5.0	3.0	3.2
September	51.5	1.2	2.5	14.0	12.2	24.5	33.2	3.5	8.7
October	52.0	—	1.5	1.0	2.0	28.0	39.5	5.5	22.5
Total	52.5	0.7	3.2	10.1	14.7	35.1	23.2	3.7	9.3

Mesenteric Fat. (Percentage distribution according to periods and according to groups).

Period	0	1	+	M	Group	0	1	+	M
August	23.5	35.5	23.0	18.0	1st (maturity stage I-IV)	1.4	10.1	39.4	49.1
September	31.2	34.0	15.0	19.8					
October	32.5	57.5	7.0	3.0					
Total	28.4	39.3	16.6	15.7	2nd (maturity st. V-VIII-II)	39.3	51.3	7.4	2.0

Age (Percentage distribution).

Age (years) Year-Classes in 1948	3 1945	4 1944	5 1943	6 1942	7 1941	8 1940	9 1939	10 1938	11 before 1938	Number of fish with readable scales
August	0.6	12.7	9.1	21.2	14.5	20.6	11.5	2.4	7.3	165
September	—	20.5	12.3	17.8	13.7	9.6	9.6	5.5	11.0	73
October	6.0	24.0	6.0	6.0	20.0	14.0	4.0	10.0	10.0	50
Total										
1948	1.4	16.7	9.4	17.7	15.3	16.7	9.7	4.5	8.7	288
1947	5.3	8.7	17.2	13.7	18.7	11.9	10.9	4.4	9.1	
1946	4.4	9.5	11.5	23.9	14.3	10.7	11.3	7.1	4.8	

Vertebrae.

a) Total number of vertebrae.

Period	Percentage distribution according to periods.							Percentage distribution according to groups.						
	54	55	56	57	58	59	Mean	21	22	23	24	25	26	27
Aug.	0.5	2.0	45.5	42.2	9.5	0.2	56.590	0.2	4.0	28.5	42.8	19.8	4.2	0.5
Sept.	0.5	4.2	37.0	52.0	6.0	0.2	56.595	—	2.8	24.8	51.5	16.0	4.2	0.8
Oct.	—	7.0	35.0	53.0	4.5	0.5	56.565	—	2.5	26.0	48.5	20.5	2.0	0.5
Total	0.4	3.9	40.0	48.3	7.1	0.3	56.587	0.1	3.2	26.5	47.4	18.4	3.8	0.6

b) Prehaemal vertebrae.

Groups	Percentage distribution according to groups.							Percentage distribution according to groups.						
	54	55	56	57	58	59	Mean	21	22	23	24	25	26	27
1st	—	3.1	27.5	54.4	15.0	—	56.812	—	1.7	18.5	48.4	25.1	5.6	0.7
2nd	0.6	4.2	45.2	45.9	3.9	0.4	56.496	0.1	3.8	29.7	47.0	15.7	3.1	0.6

Keeled Scales (K2).

Periods	Percentage distribution according to periods.							
	12	13	14	15	16	17	18	Mean
Aug.	0.5	11.0	42.5	38.0	7.0	0.8	0.2	14.43
Sep.	0.8	17.0	40.5	31.5	9.0	1.0	0.2	14.35
Oct.	—	7.0	38.5	38.0	14.0	2.0	0.5	14.67
Total	0.5	12.6	40.9	35.4	9.2	1.1	0.3	14.45
Group	Percentage distribution according to groups.							
	12	13	14	15	16	17	18	Mean
1st	1.0	23.0	44.3	27.9	3.8	—	—	14.104
2nd	0.3	8.4	39.6	38.4	11.4	1.5	0.4	14.585

Fig. 14.

- A. Quantity of fat content.
- B. Number of vertebrae.
- C. Number of prehaemal vertebrae.
- D. Number of keeled scales.

— 1st group (Mat. stage I to IV).
 2nd group (Mat. stage V to VIII-II).

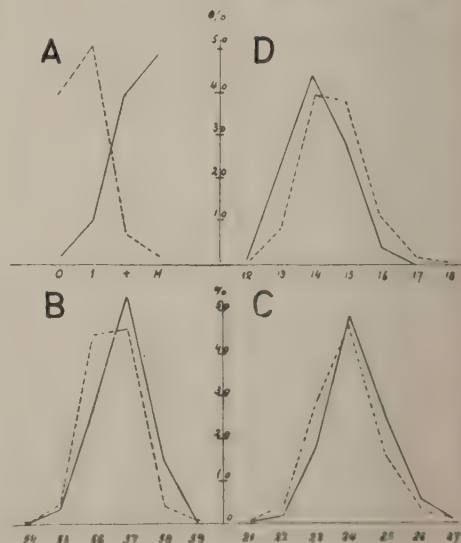


Fig. 14.

Some Considerations.

If we judge from the biological characters of each maturity stage we find again that the herring concentrations, fished by the Belgian trawlers on the Fladen and the Gut, consist of populations of different origin — at least during the period July to September — one in some way or other related to spring spawners, the other resembling the autumn spawners of the North Sea type.

The subdivision of our observations into monthly periods gave also good results. The biological composition of the concentrations proved to remain practically uniform during the months July to September, while from October it was subjected to heavy changes, i.e., an appreciable decrease in the mean size and weight, an increase in the well-advanced maturity stages and the appearance of the spent stage, a decrease in the mesenteric fat, in the vertebral mean, and in the mean of the prehaemal vertebrae, and an increase in the number of keeled scales.

All these changes indicate clearly a sudden deficiency of spring spawners, beginning with the month of October, in other words they suggest that the southerly limits of this population should be situated between 55° and 56° N. Lat.

Stomach Contents.**Percentage distribution.**

Period	full	half full	empty
Aug.	1.0	9.5	89.0
Sep.	—	10.5	89.5
Oct.	23.0	39.5	37.5
Total	5.0	15.9	79.1

Nature of contents

Aug.	schizopods, copepods
Sep.	schizopods, copepods, herring eggs
Oct.	copepods

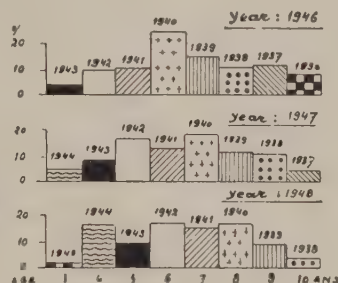


Fig. 15.
Biological scale of herring concentrations on Fladen, Gut and environment, 1946, 1947 and 1948.

Monthly Distribution of the two Herring Populations.

Months	Latitudes North	Percentage Spring-spawners	Percentage Autumn-spawners
August	58°30' — 56°	39.5	60.5
September	58° — 56°	30.0	70.0
October	57° — 55°15'	4.5	95.5
Total	58°30' — 55°15'	28.7	71.3

The frequency of the year-classes proves the presence of 5 good recruiting classes, i.e., 1944, 1942, 1941, 1940, and 1939. The 1945 class, 3-year-old herring, which appears for the first time in the concentration, is very poorly represented and constitutes thus a very bad recruiting class.

Ch. Gilis.

The Dutch Herring Fisheries in 1948.**Drift-Net Fisheries.**

As a continuation of the paper on this subject in the Vol. IV of this series we are presenting here the charts of the Dutch herring season 1948 (charts 1—16).

The charts are composed in the same way as in the previous paper. We got data of about 110 vessels, covering about 50% of the fishing activity of the whole lugger fleet. Most of the vessels were fishing with 60 nets in May, with 80 in June, and with 100 or 110 nets in the other months, the nets being set either for surface or for deeper water fishing.

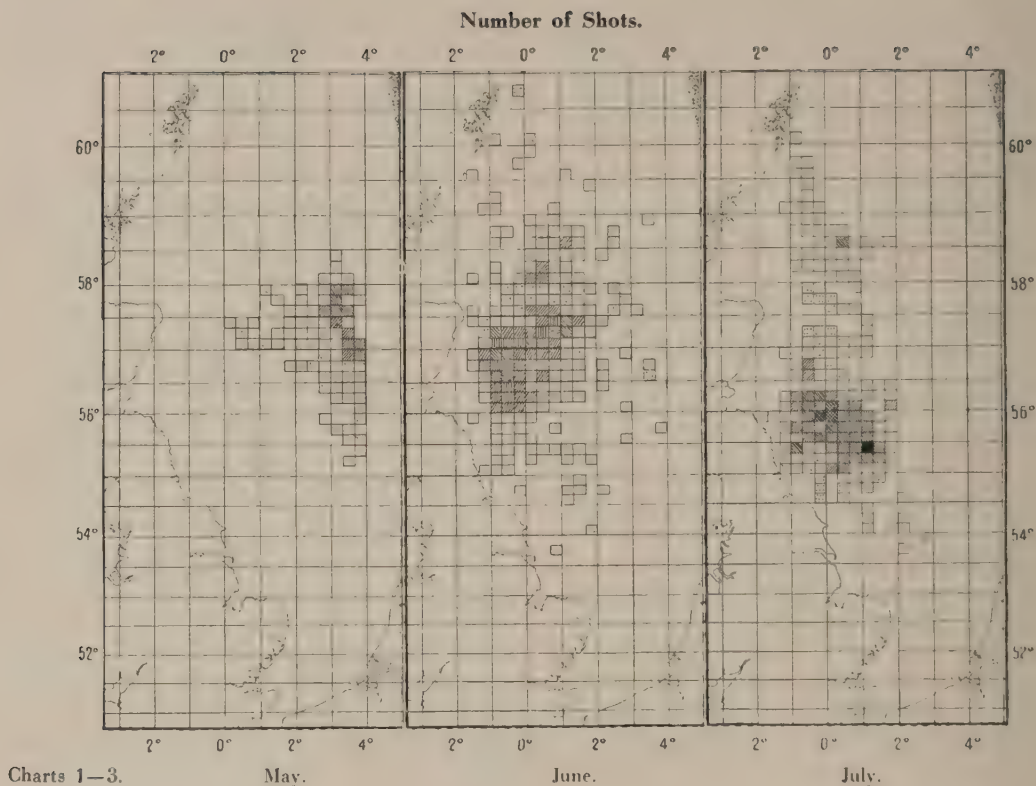
This year we got some information about the quality of the herring caught on the different grounds (matjes, full, spawning, spent). The charts No. 17—24 refer to this specification.

The distribution of the fleet in 1948 shows a difference from 1947, especially in the month of August. As the market preferred small herrings, and at that time the catches in the more northern part of the North Sea consisted of larger herrings, the fleet was fishing more to the south.

As the charts show, the mean catch per shot on the different grounds differs largely in some months when compared with the same grounds in the same months of 1947. Especially in the first months of the 1948 season, the catches were poor; in some other months the catches were better than in the previous year.

Table 9 gives the total quantity of drift-net herring landed. The total amount landed, calculated in kg., is 97,681,500 kg.

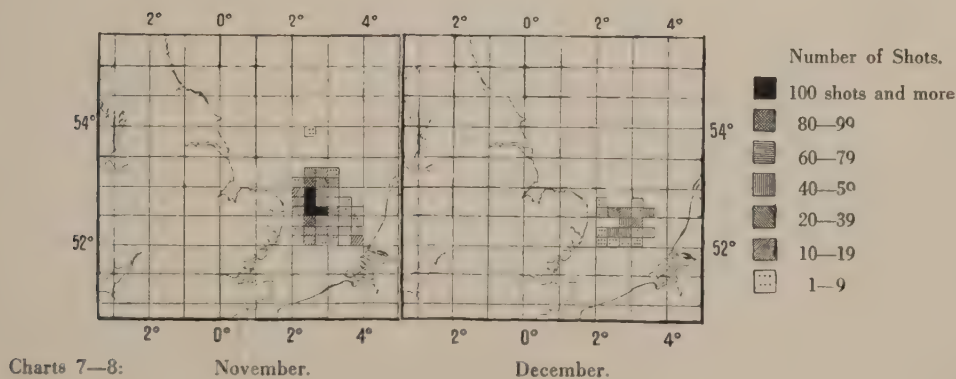
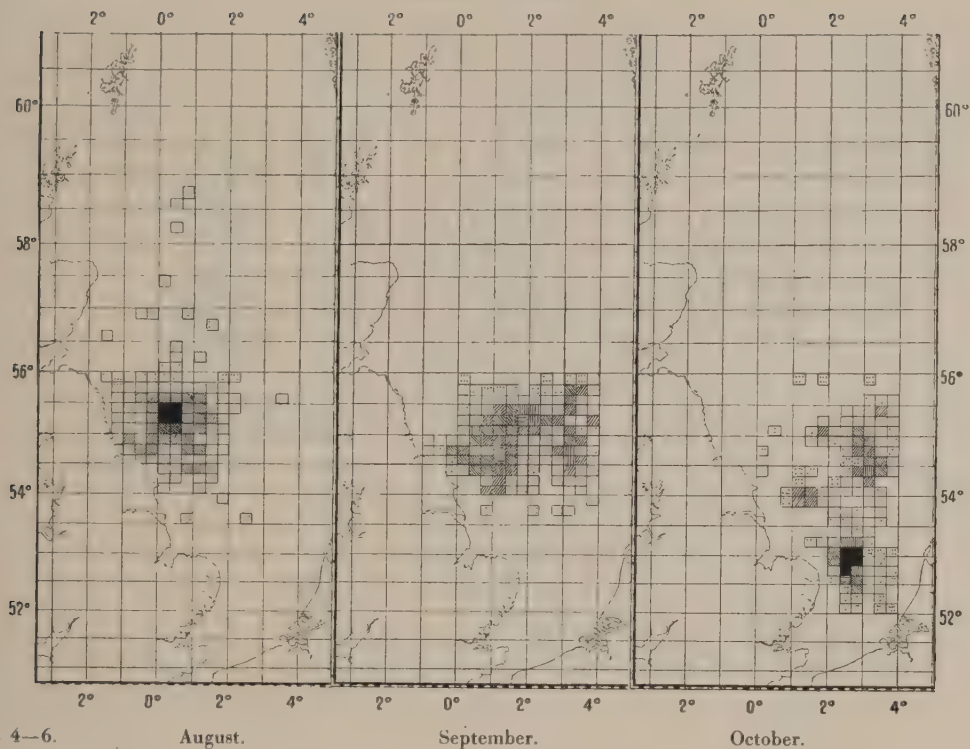
J. de Veen.



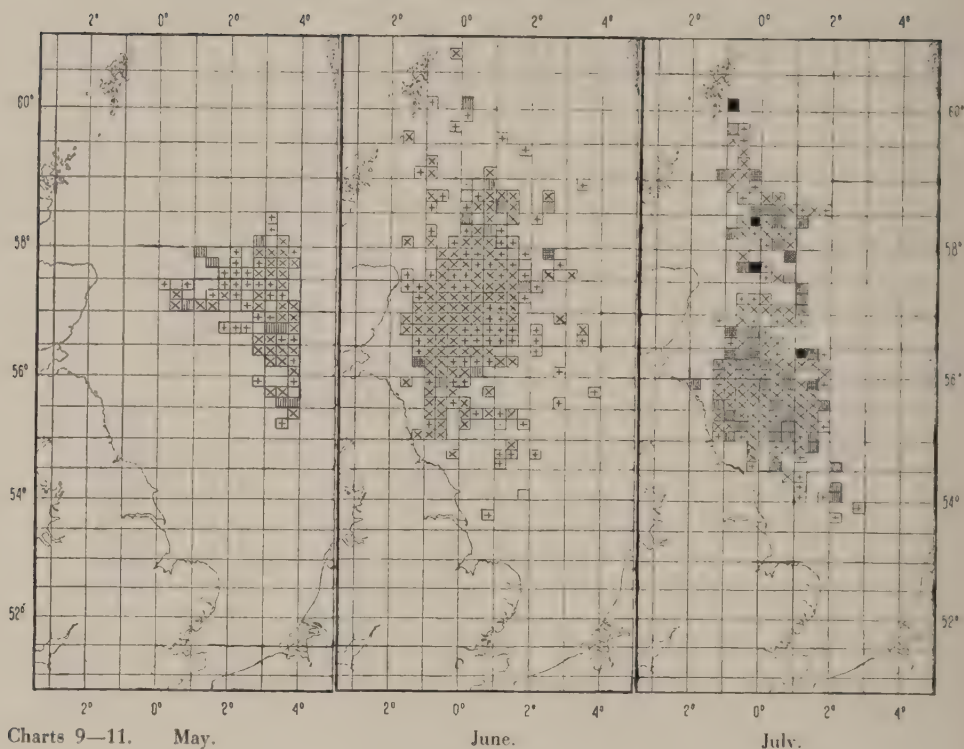
**Table 9. Quantities of Herring landed in Dutch Ports
in 1948 by the Luggers fishing with Drift-Nets.**

Month	Salted Herring (in Kantjes of 94 kg.)			Ungutted	Fresh Herring (in Kg.)
	Matjes	Gutted Full	Spent		
Jan.	—	7	22	2,473	8,500
Feb.	—	—	—	—	—
March	—	—	—	—	—
April	—	—	—	—	—
May	9,979	—	—	—	—
June	38,187	—	—	711	—
July	88,452	335	—	7,102	—
Aug.	65,277	37,408	4	11,152	10,550
Sep.	12,025	79,064	7,555	62,252	73,115
Oct.	74	53,495	9,892	170,489	1,850,635
Nov.	—	2,222	71	227,598	4,606,016
Dec.	—	973	825	72,360	892,305
Total	213,994	173,504	18,369	554,137	7,441,121

Number of Shots.



Mean Catch per Shot (in kantjes).



Trawl Fisheries.

In connection with the paper on the drift-net fisheries the data of the trawl fisheries are presented here.

Table 10 shows the quantity of herring landed by the trawlers and by the whole fleet fishing with trawlnets. The total quantity landed is somewhat bigger than in 1947, mainly by the bigger landings of spent herring caught by luggers and smaller vessels along the Belgian and Dutch coasts in the first months of the year.

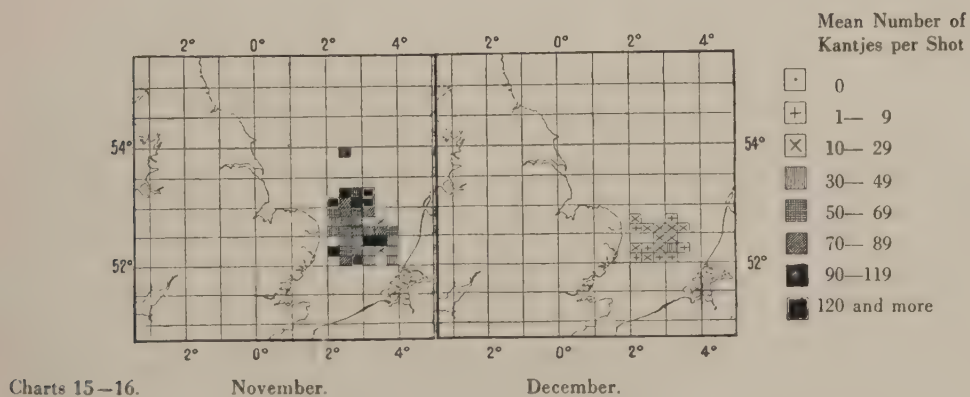
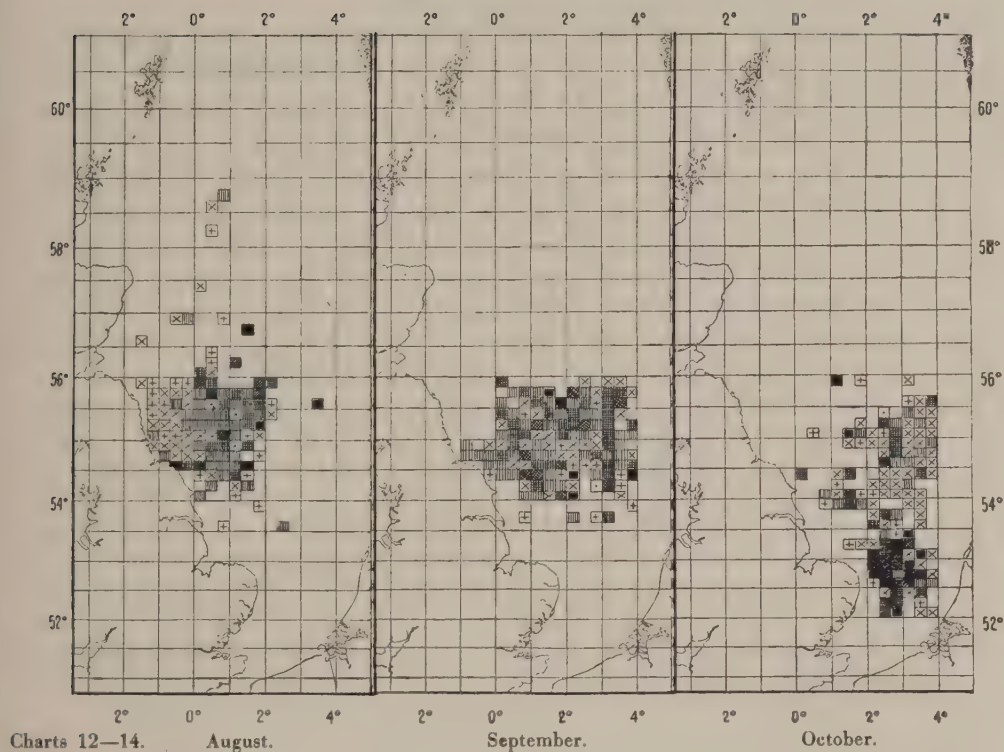
The charts 25—29 show that the density of the herring shoals in general was less than in the previous year.

L. K. Boerema.

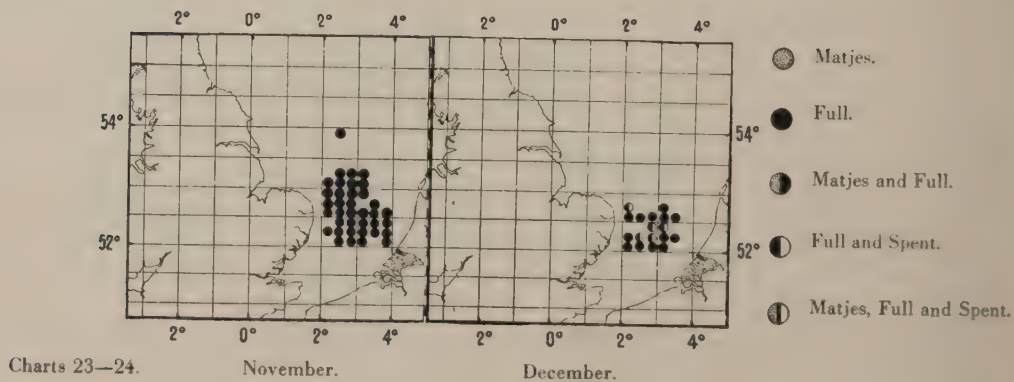
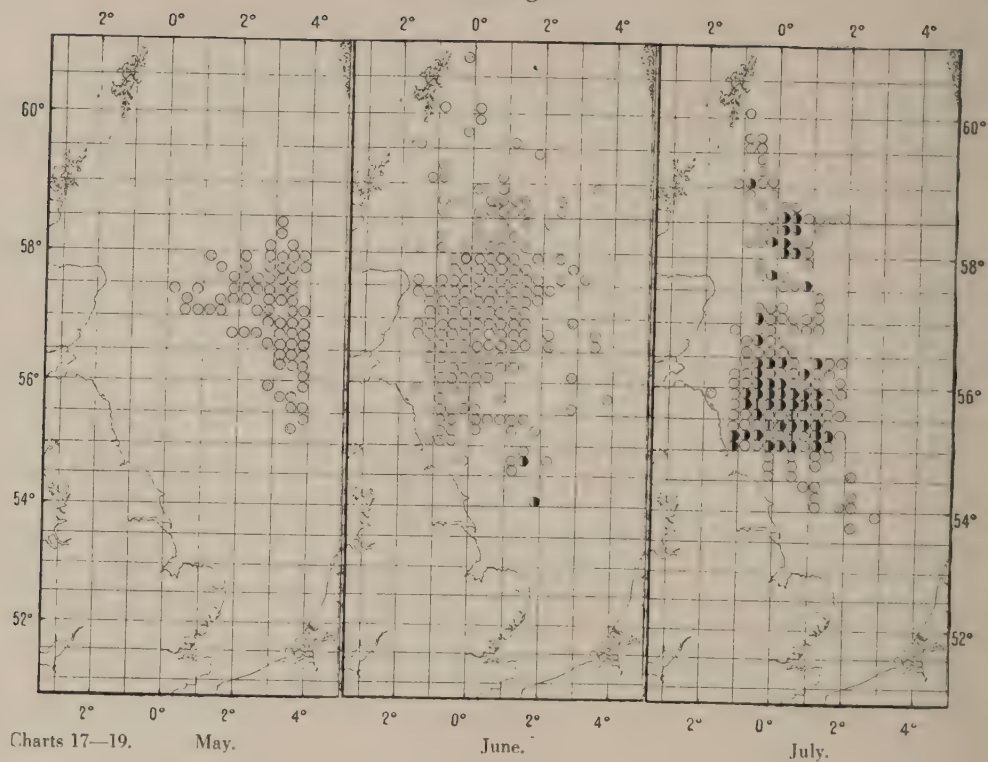
Table 10. Quantities (in tons) of trawled Herring landed in Dutch Ports in 1948.

Month	Trawlers	All kinds of vessels
Jan.	416	1,963
Feb.	611	2,501
March	214	262
April	105	132
May	91	95
June	—	—
July	1,120	1,145
Aug.	5,710	6,483
Sep.	7,168	8,982
Oct.	5,959	6,697
Nov.	2,434	2,505
Dec.	143	246
Total	23,975	31,017

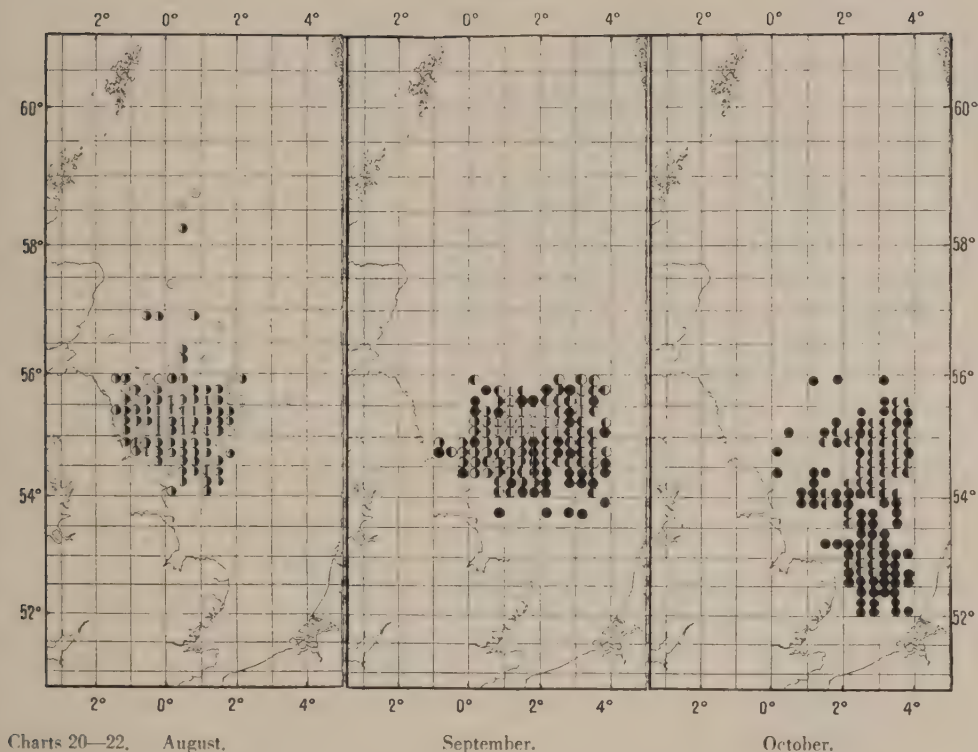
Mean Catch per Shot (in kantjes).



Sorting.

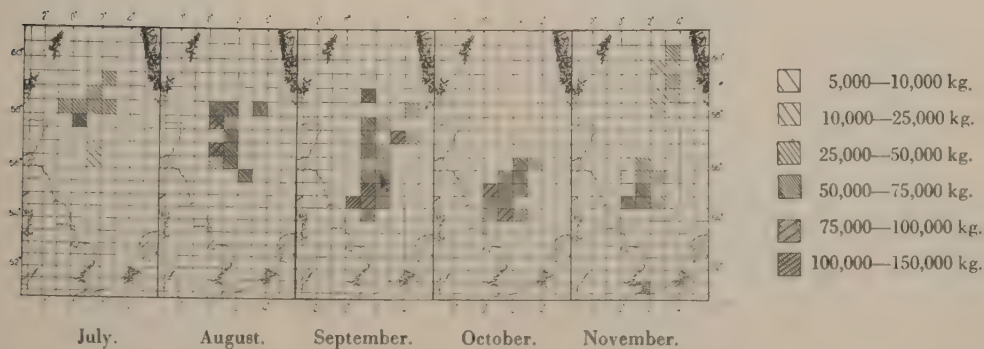


Sorting.



Mean catch (in kg.) per 100 hours fishing.

Charts 25—29.



Danish Investigations.

Table 11. Herring caught by Trawl from Danish Cutters in 1948.

Date and Locality of Samples.									Racial Characters.					
Fladen		25/9		58°0'N. 1°0'E.					Date	Maturity	No. of indiv.	V. S.	V. P.	K ₂
N. of Dogger		7/10		56°0'N. 3°0'E.										
Maturities (%). (In brackets: No. of Fish only measured).									25/9	II, III	30	56.93	23.97	14.27
										V, VI, VII	73	56.76	23.77	14.86
										VIII	14	56.3	23.8	14.6
Date	II	III	IV	V	VI	VII	VIII	No. of fish exam.	7/10	IV, V	60	56.60	23.93	14.88
25/9	5	19	2	45	4	13	12	120 (+46)		VII, VIII	59	56.50	23.98	14.90
7/10	1	—	2	49	—	34	14	120 (+56)						

Length Distribution (%).

Date	Maturity	20	21	22	23	24	25	26	27	28	29 cm.	Total
25/9	II, III	—	—	—	—	1	1	5	11	4	—	22
	IV	—	—	—	—	—	—	—	1	—	1	2
	V, VI, VII	—	—	—	—	—	4	22	31	4	1	62
	VIII	—	—	—	—	—	1	2	4	5	1	13
	Total	—	—	—	—	1	6	29	47	13	3	99
7/10	II	—	—	1	—	—	—	—	—	—	—	1
	IV, V	1	1	10	11	8	10	7	3	1	—	52
	VII, VIII	—	—	3	—	5	9	12	12	7	—	48
	Total	1	1	14	11	13	19	19	15	8	—	101

Number of Winter Rings on the Scales (%).

Date	Maturity	2	3	4	5	6	7	8	9	10	11	12
25/9	II, III	1	14	5	4	—	—	—	—	—	—	—
	IV	—	1	—	—	—	—	—	—	—	—	—
	V, VI, VII	—	6	12	14	13	7	3	5	2	—	1
	VIII	—	1	1	4	4	—	2	—	—	—	—
	Total	1	22	18	22	17	7	5	5	2	—	1
7/10	II	—	1	—	—	—	—	—	—	—	—	—
	IV, V	24	9	11	2	4	2	—	—	1	—	—
	VII, VIII	5	5	9	4	10	8	4	1	1	—	—
	Total	29	15	20	6	14	10	4	1	2	—	—

Fat Content of ungutted Herring (%).

Fladen 25/9		N. of Dogger 7/10	
Maturity	%	Maturity	%
III	13.0	V	13.0
V	12.5	VII	7.7
VII, VIII	8.5	VIII	15.2

120 fish from each sample were examined; besides, length measurements were made of 46 fish from the September sample and of 56 fish from the October sample.

Moreover a sample taken off Egersund c. 7/8 had been secured, but it has not yet been examined.

From the racial analysis it will be seen that most of the herring were autumn spawners, but that the immature herring caught on 25/9 were spring spawners.

Aage J. C. Jensen.

Scottish Investigations.

The drift-net fishery at Shetland was successful throughout the greater part of the summer of 1948. Off the north-east coast of Scotland, on the other hand, catches were rather poor. There was no evidence of substantial recruitment by 3-year-old fish and the stock was probably poorer than during the previous two summers. Furthermore, the fishery was handicapped by the presence of large numbers of dogfish, *Acanthias vulgaris*, on grounds between Wick and Peterhead, which caused drifters to desert grounds which are normally productive.

The prevalence of easterly winds was regarded also as having an adverse influence on the fishery. Their effect on drift-net catches is not fully understood, but it is possible that the deepening and

Table 12. Size Distribution to nearest cm. (per mille).

No.	Date	cm.: 18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	No. of Fish
Commercial Drifters:																			
1	9.4.—10.5.	—	—	—	—	—	—	4	13	119	342	408	103	11	—	—	—	—	717
"Clupea":																			
2	7.—13.7.	—	—	—	—	—	—	—	7	76	290	402	200	21	3	—	—	1	828
3	17.7.	—	—	—	—	—	—	—	17	57	295	517	114	—	—	—	—	—	176
4	9.—17.6.	—	—	—	—	21	88	120	155	199	201	171	40	6	—	—	—	—	451
5	3.7.	—	—	5	—	21	64	123	171	246	182	150	37	—	—	—	—	—	187
6	3.—10.6.	—	—	—	8	45	56	71	164	232	240	153	31	1	—	—	—	—	499
7	19.6.	—	—	—	—	—	—	35	69	200	372	248	69	—	—	—	7	—	145
8	23.—27.7	—	—	—	10	4	8	66	165	268	250	171	48	10	—	—	—	—	503
9	5.8.	—	—	—	—	23	23	131	208	292	208	100	15	—	—	—	—	—	130
10	11.8.	—	—	—	—	—	—	—	59	195	238	250	164	74	12	8	—	—	256
11	12.—24.6.	3	2	—	8	48	86	144	183	220	164	121	20	—	—	—	—	—	1012
12	24.—28.7.	—	—	3	12	6	27	99	195	272	186	116	69	16	—	—	—	—	236
13	4.8.	—	—	18	—	73	209	273	209	145	73	—	—	—	—	—	—	—	110
14	6.8.	—	—	—	—	—	44	109	98	98	141	217	239	54	—	—	—	—	92
15	10.8.	—	—	—	—	—	—	4	15	136	180	379	250	29	7	—	—	—	272
Commercial Herring Trawl:																			
16	1.9.	—	—	—	—	—	—	4	4	56	288	412	208	28	—	—	—	—	250
17	7.9.	—	—	—	—	—	—	—	8	32	308	457	178	12	4	—	—	—	247
18	15.9.	—	—	4	4	4	—	4	4	63	270	460	168	18	—	—	4	—	285
19	21.9.	—	—	—	—	—	—	—	4	111	294	363	198	27	4	—	—	—	262

Areas: No. 1, between Bressay Bank and Patch.

No. 2, near east coast of Shetland.

No. 3, north-west edge of Bressay Bank.

Nos. 4 and 5, between Long. 1°00'W. to 3°00'W. and Lat. 58°00' to 59°00'N.

Nos. 6 to 10, between Long. 0°00' to 2°20'W. and Lat. 57°45' to 58°20'N.

Nos. 11 to 15, between Long. 0°00' to 2°00'W. and Lat. 57°00' to 57°45'N.

Nos. 16 to 19, Fladen Ground.

intensifying of the thermocline associated with easterly winds may restrict the vertical movements of the shoals.

The material examined between the spring and autumn of 1948 consisted of samples caught (1) by commercial drifters between Bressay Bank and the Patch in April and May, (2) by the research vessel "Clupea" between 9th June and 11th August and (3) by commercial herring trawlers on the Fladen Ground in September. The grounds sampled by "Clupea" extended from the east coast of Shetland to the latitude of Peterhead. An experimental series of drift-nets was used having different sizes of mesh, which in the series measured from 31 to 48 meshes per yard.

Results have been summarized in 4 tables, giving respectively size distribution, maturities, age composition and counts of Vert. S. The serial Nos. in Tables 13—15 correspond with those in Table 12.

It has been the practice in Scotland to make counts of K_2 ; unfortunately staffing difficulties made it impossible to include this character in the observations during 1948. It was likewise impossible to make counts of Vert. S. in every case.

Samples have been combined whenever there was little difference in time and place of capture and

when there was close agreement in their biological features.

Length measurements made to the nearest mm. are here recorded to the nearest cm. Age composition, expressed as the number of winter rings on the scales, is based on samples of scales taken from each individual fish, from which two clearly marked scales selected under the microscope have been mounted permanently.

The majority of the herring caught between Bressay Bank and the Patch in April and May consisted of recovering spents, which according to the vertebrae counts must have spawned in autumn or late autumn of the previous year.

Spring spawners were unusually scarce on all grounds sampled and were prominent only among the relatively few fish caught at maturity stage I on the Bressay Bank—Patch area, at stages I and II on the Shetland grounds in July and at stages I and II on the Fladen in September.

An important feature is the predominance of the year-class autumn 1941 among the coastal spawners in August and the spents from the Fladen Ground in September.

An age-group with three winter rings on the scales, and having predominantly the "race" charac-

Table 13. Maturities. Per Mille.

No.	I	II	III	IV	V	VI	VII	VII-II
1	130	120	4	—	—	—	279	467
2	37	298	469	137	44	—	—	15
3	119	136	722	23	—	—	—	—
4	192	514	177	31	—	—	—	87
5	139	273	433	107	43	—	—	5
6	234	366	96	11	—	—	—	293
7	48	786	138	14	—	—	—	14
8	32	231	312	310	116	—	—	—
9	54	100	162	423	231	23	8	—
10	—	27	273	281	410	—	8	—
11	293	460	133	24	—	—	—	90
12	80	201	464	171	85	—	—	—
13	18	36	155	345	418	9	18	—
14	33	174	87	33	11	33	630	—
15	—	15	22	290	467	195	11	—
16	96	200	128	268	192	16	100	—
17	36	165	134	381	146	4	134	—
18	70	225	186	182	123	4	211	—
19	8	84	305	168	23	—	412	—

ters of autumn or late autumn spawners, was prominent on the drift-net grounds off NE. Scotland in June, July and first half of August, and on the Fladen in September. This group, however, does not appear to have made a conspicuous contribution to the Scottish autumn spawning shoals in 1948; see end of Table 14.

Tagging experiments, using an external tag, were attempted at the end of July and early in August, and about 900 herring were liberated in good condition. Unfortunately, the fishery came to an end soon afterwards and only one tagged herring was recovered. This herring was caught after ten days freedom and at a position about 20 miles from the place of liberation.

H. Wood.

Swedish Investigations.

Spring Spawning Herring.

I have previously endeavoured to prove that the autumn spawning herring, caught on the Fladen Ground during August and September, is the same herring population which during the following winter is caught off the Swedish west coast.

Now I should like to make a few remarks concerning the spring spawning herring in the northern North Sea. As is well known the catches on the Fladen Ground are more or less mixed up with spring spawners. I want to draw attention to some samples I have investigated this year. Of one sample caught off Egersund on the south-west coast of Norway (58°3'N.L. — 4°55'E.L.) on 17. August 1948, $\frac{2}{3}$ consisted of spring spawners. I was somewhat astonished to see that most of these herring had their stomachs filled with the pteropod *Limacina retroversa*. During a rather short time in August Swedish fishermen landed at the Swedish fishing ports from this place some 2,000 to 2,500 tons

Table 14. Age Composition. Per Mille.

No.	1	2	3	4	5	6	7	8	9	10+	Winter Rings
1	—	—	176	115	237	213	118	80	33	27	
2	—	4	179	110	222	179	149	94	43	20	
3	—	11	119	74	131	182	261	125	57	40	
4	—	183	246	108	164	116	54	50	52	28	
5	5	225	353	150	123	64	64	16	—	—	
6	—	137	241	109	229	134	60	54	18	18	
7	—	28	103	41	276	179	179	69	76	49	
8	10	66	371	155	211	115	48	12	4	8	
9	23	85	285	162	162	108	100	54	23	—	
10	—	12	191	129	199	191	74	78	59	67	
11	5	207	320	110	166	103	46	22	13	6	
12	10	171	247	178	166	90	78	39	14	9	
13	9	200	391	118	118	91	27	36	9	—	
14	—	130	228	163	109	152	76	41	51	41	
15	—	7	202	129	129	276	77	107	33	40	
16	—	4	304	68	104	104	152	104	112	48	
17	—	—	235	73	93	93	194	178	81	53	
18	11	4	418	67	88	116	109	109	53	29	
19	—	—	130	69	225	214	126	130	57	50	

Ripe and Spent Fish from Coastal Area.

August

— 135 135 155 282 82 106 49 57

Spent Fish from Fladen Ground.

September

— 53 58 159 261 155 146 111 58

Table 15. Vert. S.

Area	Mat.	53	54	55	56	57	58	59	Mean	No. of fish
Bressay Bank—Patch	I	—	—	1	23	56	12	—	56.86	92
	II	—	—	8	42	33	2	1	56.37	86
	VII/VII-II	—	—	29	243	236	25	—	56.48	533
Shetland	1) I/II	—	—	—	3	17	1	—	56.90	21
	2) II/VII-II	—	—	6	58	44	4	—	56.41	112
	III-V	—	1	4	57	46	3	—	56.41	111
Scottish NE. Coast Between Long. 0°00' to 2°20' W. and Lat. 57°45' to 58°20' N.	I	1	1	4	50	59	5	—	56.50	120
	II/VII-II	—	—	15	130	126	14	—	56.49	285
	II/VII-II	—	—	7	50	50	9	—	56.53	116
	III-IV	—	—	2	9	11	—	—	56.41	22
" "	I	—	—	—	5	10	1	—	56.75	16
	II	—	1	7	50	46	9	1	56.51	114
	III-V	1	3	27	188	141	7	—	56.32	367
Scottish NE. Coast Between Long. 0°00' to 2°00' W. and Lat. 57°00' to 57°45' N.	I	—	1	10	77	98	18	1	56.50	205
	II/VII-II	—	1	9	70	100	6	—	56.54	186
	IV-VI	—	—	11	128	117	9	—	56.47	265
15 " "	VII	—	—	4	29	27	—	1	56.43	61
19 Fladen Ground	I	—	—	—	16	27	11	1	56.95	55
	II	—	—	1	37	111	27	—	56.93	176
	III	—	1	7	60	107	22	—	56.72	197
	IV-VI	—	—	14	179	177	15	1	56.51	386
	VII	—	—	14	100	104	7	1	56.47	226

1) 2 to 4 Winter Rings.

2) 5 to 12 Winter Rings.

of herring of the same kind. They consisted mainly (86%) of 4-summer-old, very large, herring. The fishing came to an end very soon, because the herring, being filled up with *Limacina*, were not very well fitted for salting.

I have also analysed two samples from the Fladen Ground caught on 7. and 31. August 1948. In these samples there were also a good many spring spawners, most of them again 4 summers old (80% and 87% respectively). The herring in these two samples had no food in their stomachs.

For comparison I also give the analysis of one sample from the previous year, caught on the Fladen Ground on 28. August 1947. In this sample the spring spawners were mostly 3 summers old (55%), i.e. the same year-class as in the three samples from August 1948.

During the following winter I analysed two samples caught off Måseskär lighthouse, on the west coast of Sweden, on 29. November 1947 and 27. January 1948. The samples from November consisted mostly of spring spawners, but in the January sample only a few were spring herring. Yet in both

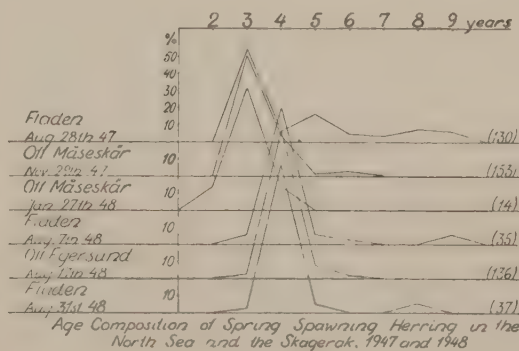


Fig. 16.

these samples the 3-summer-old herring dominated greatly (71 and 72% respectively), thus the same year brood as the samples from Egersund and Fladen, i.e., from the spring of 1945 (see diagram Fig. 16).

The spring spawners in all these samples are large for their age and their length is very nearly the same from all the areas (see diagram Fig. 17).

Many years ago the late Dr. A. C. Johansen proved that in the Kattegat there is a spring spawning herring with a high number of vertebrae averaging up to nearly 57. In both the samples from Fladen during August 1948 and off Egersund the spring herring have an average number of vertebrae very close to 57. But the sample from Fladen on 28. August 1947 shows a somewhat smaller number, namely 56.73. We must remember, however, that it is in some way difficult, in a sample consisting of different populations, with certainty to pick out the spring spawners. It may be that some other herring are mixed with them which lower the average number. The same can be said about the average number in the samples from the area off the Swedish west coast caught on 29. November 1947 and 27. January 1948 with the average numbers of 56.85, and 56.88.

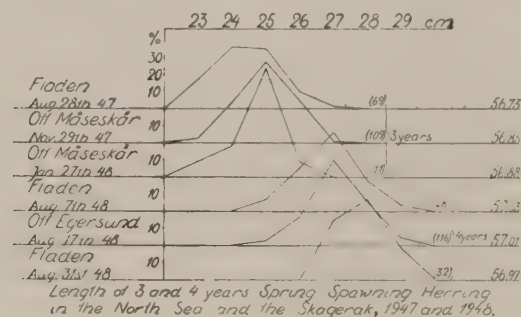


Fig. 17.

But previously I have investigated a number of samples of spring herring from the eastern Skagerak and the Kattegat with the vertebral number averaging very near to 57. I can for instance mention a sample from the area to the north of the Skaw, caught on 10. October 1946, and having an average number of 56.98. Again, in a sample caught on 3. February 1947, from nearly the same place, I found the average number to be 56.97.

Of particular significance was a sample from the northern part of the Swedish west coast, caught on 2. March 1943. The catch consisted only of spring herring, just spawning or very near spawning. The analysis of their vertebrae was as follows:—

55	56	57	58	59	60	
2	48	99	48	2	1	= 200
Average 57.02.						

It seems to me that there are good reasons for supposing that the large spring spawning herring of the eastern Skagerak and the Kattegat are very

closely related to the spring spawners off Egersund and on the Fladen Ground, if they are not indeed of the same population. If this is the case, which I think is very likely, then we may have to postulate a migration by this herring from the spawning places in the eastern Skagerak and the Kattegat far away to the North Sea in late spring and early summer. I do not believe that the whole of this population spawns in the waters off the Swedish west coast, but a part of it. This herring really spawns in the Kattegat and the eastern Skagerak and in the archipelago along the northern part of the Swedish west coast.

K. A. Andersson.

Sprat.

Norwegian Investigations.

The Norwegian fishery for sprat takes mainly place in the Oslofjord and the fjords on the western

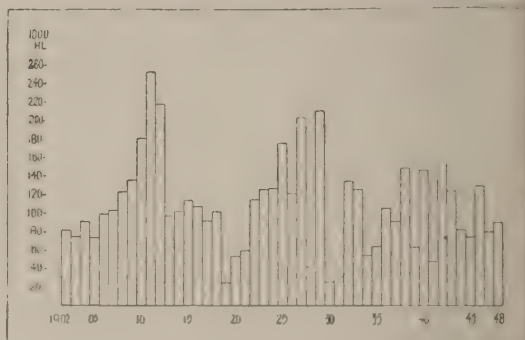


Fig. 18. The Output of the Sprat Fisheries in Norway during the years 1902-1948.

coast of Norway. Most of the catch is taken by purse seines during summer and autumn. At the Skagerak coast of Norway the output of the fishery is insignificant. During the last years Norwegian fishermen have, however, taken up trawl fishery for sprat in the Skagerak, especially on the grounds near Skagen.

The fishing in the fjords is mainly based upon immature fish in their second summer. In certain areas, for instance the Oslofjord, older fish are of more importance. And the catch taken with trawl in the Skagerak mainly consists of older fish. But generally speaking the fishery is mainly based upon a single year-class.

This fact should be kept in mind when studying the output of the fishery, which exhibits very accentuated fluctuations. As will appear from Fig. 18 there have in some years been caught more than 200,000 hl., in other years only 20,000 hl., the mean for the period dealt with being about a hundred thousand hl.

As pointed out by Bjerkén (1930) the output

If the fishery is influenced by a great number of factors. There is no doubt, however, that from one year to another great fluctuations occur in the abundance of young fish. This may partly be due to fluctuations in the strength of the year-classes, but other factors may also be of importance.

Sund (1911) assumes that the occurrence of young sprat along the western coast of Norway is due to an influx of fry from the spawning areas in the Skagerak and adjacent waters. Factors which influence the drift of the fry are therefore of importance to the abundance of the fish in the usual fishing areas.

During the last 2 decades the sprat have, according to information from Bjerk an, spawned in the western fjords to a greater extent than previously. In this connection it should be mentioned that a closer examination of the output of the fishery

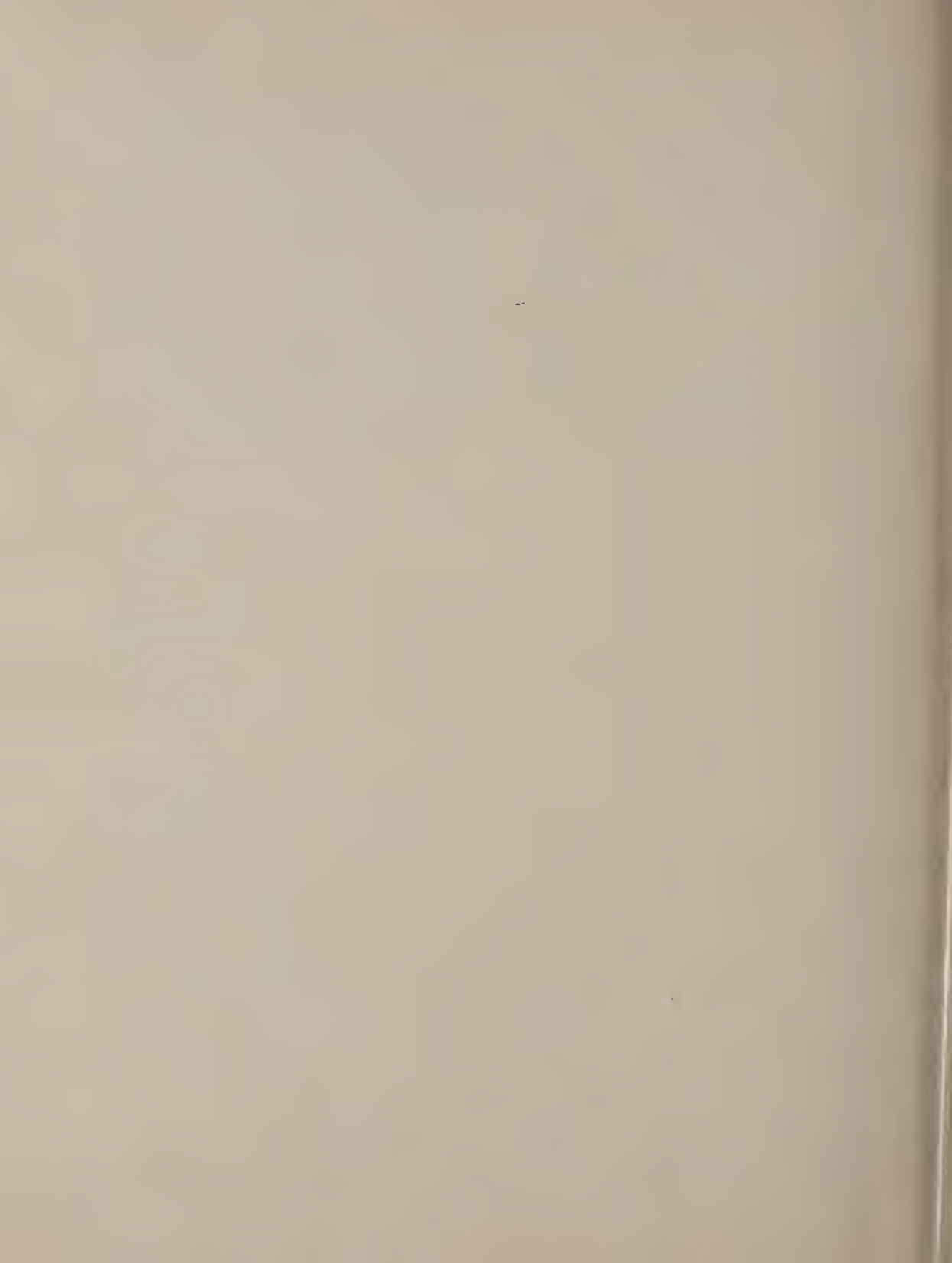
has revealed that the main fishery at the western coast in the last years has shifted somewhat to the north.

At present we do not know the importance of the spawning within the various localities to the recruitment of the stock in our waters. We hope, however, to be able to throw some light on this problem in the following years.

G. Dannevig.

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Southern North Sea.

INTRODUCTION.

THE investigations of 1948 were continued along the general lines pursued in 1947 and remained on much the same scale, the main effort being devoted to research on the plaice and herring. A considerable handicap to investigations planned to extend studies of the spawning grounds of the plaice, the drift of larvae and post-larvae, and the distribution and density of the 0 and I-group fish in coastal waters has been the continued existence of uncleared minefields off the Belgian, Dutch and German coasts, and in the Helgoland Bight.

In addition to the contributions appearing here, hydrographic and plankton observations relevant to annual changes in the Committee's area were made by England and Denmark in connection with the May and September international surveys arranged by the Hydrographic Committee.

Environment.

Hydrography. Temperatures in the winter 1947—48 were higher in the Southern Bight than in the winter 1946—47, and it appears from the figures given by Mr. Helge Thomsen that at the "Vyl" Lightship between October 1947, and November 1948, surface and bottom temperatures were higher than the average in all months except July. Surface salinities were above normal at the "Vyl" Lightship over the same period in all months except April, May, June and July, and bottom salinities were over normal for all months except July.

Plankton. The standing crop of dried Hensenet plankton of the Flamborough—Dogger area differed from that of 1947 in the relative importance of the two maxima. Except in May when the fat content was unusually high, this index did not reach such high values as in 1947.

Fish Species.

Fish Eggs and Young Fish. Mr. Simpson's survey of the plaice spawning ground has revealed in whole or part the distribution of eggs and larvae

of nine species of fish in the Southern Bight for the winter of 1947—48. There was little difference in the area covered by the eggs and larvae in the two years, and it is not thought that the cold spell of February 1947 caused any spatial displacement. The cod, two species of whiting and the herring were, however, later starting to spawn in 1948 than in the previous year and the eggs and larvae of the dab were more numerous.

The Demersal Catch. Dutch and English observations both indicate an increase in the hours of fishing by steam trawlers in the southern North Sea, together with a decline in the catch per days absence or per 100 hours fishing. On the other hand, there has been increased fishing by the smaller inshore and near-water trawlers, the resultant increased catch being made up of flat fish.

Cod. The cod catch-rate has dropped between 1947 and 1948 in the Dutch fishery, but the investigators of that country consider that the stock has remained nearly stable since the second half of 1947.

Haddock. A decline in the catch per 100 hours fishing and in the total catch of the Dutch fishery has been explained by Cox-Heikens and Boerema as exceptional and due to the fishing out of strong year-classes.

Plaice. English, Dutch and Danish investigations on the plaice all point to the relative importance of the younger age-groups and their greater density on the grounds. The English measurements suggest that there was a strong recruitment of small plaice in the second half of 1947, and the first half of 1948. Reference to an increased population of small plaice in 1948 is also made by Dr. Jensen, and in the Dutch—English work it was found that the small plaice of the inshore fishery had increased in density compared with 1947, while, on the other hand, the catch per 100 hours of the larger plaice from the deeper water had declined.

The increase in the yield of fish from the Rye Bay area was due to the strength of the age-groups III and IV, mainly composed of brood from 1945 and 1944. A good II-group was also present suggesting a 1946 brood of substantial strength, but

not so good as that of 1945. There was also an increase in the importance of the younger age-groups in the English steam trawler catch from two areas in the southern North Sea, although the catch per 100 hours fishing dropped to 82 % of its 1947 value.

While the signs are that the heavy recruitment of a series of strong brood years since 1943 may slow down the rate at which the landings of plaice return to the 1938 level, it is also to be noted that the English results suggest that the numbers of fish caught in the age-groups over V have not declined so rapidly between 1947 and 1948 as they did between 1946 and 1947.

The English contribution shows that length for age has decreased in the Rye Bay area but in the North Sea areas there has been a tendency for length to increase compared with 1947. Danish observations indicate a drop in length for V-group fish in three North Sea seine-fishing areas out of four, when 1948 is compared with 1946. Observations on the average weight at age made in the English investigations show that the plaice of the inshore fishery at Rye Bay were lighter than in the previous year, while in the North Sea there was little change in the majority of the year-classes, only a few of them being lighter.

Herring. The 1947—1948 fishery for spent herring was the subject of investigations by both France and Belgium, the French investigation revealed the 1942 and 1944 broods as dominant and in this resembled Dr. Hodgson's finding in respect of the East Anglian Fishery for 1947, the

results of which were published in the previous volume of *Annales Biologiques*. While the Belgian work confirmed the strength of the 1912 and 1944 broods, it showed the contributions of 1936 and 1938 to be even stronger numerically.

The spent herring fishery was mainly close inshore in the Ostend—Zeebrugge area, finishing up off Walcheren, and north-east thereof. M. Gilis has shown that the Belgian fishery for spent herring has fallen in a remarkable way since the southern North Sea drift-net fishery started after the war. The catch per day per horse-power and the total catch of the fishery have fallen to about 20 and 11 % of what they were at their height in 1942—43, and it seems reasonable to agree with M. Gilis when he points out that the stocks of herring in the southern North Sea are substantially affected by the autumn drift-net fishery.

It is interesting to note as a confirmation of the English observations in the East Anglian fishery in 1947 that the Belgian data give the average weight and fatness of the spent herring higher in the season 1947—1948 than in 1946—1947.

From Dr. Hodgson's account of the East Anglian fishery in the autumn of 1948 it appears that the 1942 and 1944 broods were once again the most important constituents of these shoals. The drifters at work in 1948 had increased to 430 compared with 400 the year before, and the catch increased from 406,316 to 476,016 crans, the catch per landing increasing at Yarmouth but decreasing at Lowestoft.

R. S. Wimpenny.

ENVIRONMENT.

Hydrography.

Table 1. Monthly Mean of Salinity at Surface and Bottom at the Lightvessel "Vyl" for a longer Series of Years, and Anomalies from this Mean.

(From the Danish Meteorological Institute, Nautical Department.)

Surface.													
	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX
Mean	32.4	32.4	32.9		32.6	32.4	32.2	32.4	32.3	32.6	32.5	32.4	32.6
1947	1.2	1.6	1.0	1948	0.6	1.0	0.5	—1.5	—0.3	—0.8	—0.3	0.1	0.1
Bottom.													
Mean	32.6	32.7	33.0		33.0	32.8	32.7	32.8	32.6	33.1	32.9	32.7	32.8
1947	0.9	1.6	1.2	1948	0.6	1.4	0.3	0.2	0.6	—0.4	0.1	0.3	0.3

Monthly Mean of Temperature at Surface and Bottom at the Lightvessel "Vyl" for a longer Series of Years, and Anomalies from this Mean.

(From the Danish Meteorological Institute, Nautical Department.)

Surface.													
	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX
Mean	12.2	8.5	5.4		3.2	2.2	2.6	4.8	8.8	12.4	15.2	16.1	15.0
1947	1.7	1.0	1.5	1948	1.2	1.5	0.6	2.2	1.3	1.1	—0.1	0.6	0.4
Bottom.													
Mean	12.7	9.0	6.2		3.9	2.6	3.0	4.7	7.9	11.1	14.1	16.0	15.2
1947	1.6	1.2	1.1	1948	1.1	1.9	0.4	1.1	0.4	1.3	—0.3	0.2	0.5

Helge Thomsen.

Plankton.

The Dry Weight and Fat Content of Plankton.

Dried Hensen-net samples were collected each month from the Flamborough—Dogger Bank area as described in last year's contribution to *Annales Biologiques*. The results from dry-weight and fat-content are shown in Figure 1.

The dry-weights resembled 1947 in reaching maxima in the early summer and late autumn, but the first maximum was lower and the second higher than in that year. On the whole 1948 was slightly inferior to 1947.

The fat-contents of 30 and 40 % found in May were attributable to the diatom *Coscinodiscus concinnus* and have no parallel since 1933 when a similar state of affairs was found in April and May, when the same species was involved. Outside May the fat percentages did not reach the same levels as in 1947.

R. S. Wimpenny.

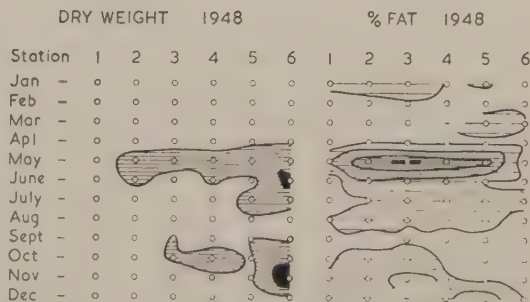


Figure 1. Total solids and percentage fat for Hensen-net hauls from six stations between Flamborough Head (Station 1) and the SW. Patch of the Dogger Bank (Station 6). The total solids are contoured at 0.05 (close lines) and 0.1 gm. per cubic metre and the percentages of fat at 10 (wide spaced lines), 20 (medium spaced lines), 30 (close spaced lines), and 40 (black).

THE FISH.

Notes on the Occurrence of Fish Eggs and Larvae in the Southern Bight of the North Sea during the Winter of 1947—48.

By

A. C. Simpson.

THE plaice egg surveys of 1947—48 have again yielded, as a by-product, some further information on the distribution of eggs and larvae of fish other than plaice, and these data form the material of this contribution. The same procedure has been followed here as was adopted in the previous paper (Simpson, Ann. Biol. IV), with the addition of charts of surface temperature. To give the complete picture the total eggs and larvae of the plaice are included this year, though the distribution of the plaice eggs will be discussed in greater detail in a report on the spawning of the plaice which will be published in *Fisheries Investigations*.

The data suffer from the same incompleteness as before, due to the selection of the area to cover the spawning of the plaice and therefore only covering those parts of the spawning of the other species, which happen to fall in this predetermined area.

The surveys were carried out by making at each station three hauls of the Hensen net from the bottom to the sea surface and plotting on the accompanying charts the total numbers of eggs and larvae for each species caught in this column of water of 1 sq. m. in section. Compared with the 1946—47 surveys, the present series do not extend so far south, stopping at the Straits of Dover, but in the survey of March 3—8, the area covered was extended as far north as 54°N. The surveys of February 24—29 and March 3—8 covered adjacent areas and both have always been plotted on the same chart. The areas covered by these two surveys are shown in Chart 14 where the broken line divides the stations of the earlier southern survey from those of the later northern survey.

The winter of 1947—48 was relatively mild and the temperature of the water was some two degrees above that found the previous year, excluding the abnormal cooling that occurred in February 1947. The difference between surface and bottom water is so small in this area at this time of year that the surface temperature can be taken to indicate the condition throughout the water column.

A comparison of the February—March 1948

survey with the March 1947 survey, which latter was carried out immediately after the cold weather, does not show that, in the area south of 52°N., did the lowering of the temperature during February 1947 greatly affect the position of spawning of the various species.

In this brief note presenting the data as soon as they are available it is only possible to point to several interesting features without discussing their significance at any length.

These surveys show the importance of the Southern Bight as a spawning area for the North Sea winter spawning fish, though it must not be forgotten that most of these species do spawn larger numbers of eggs in other areas of the North Sea.

These charts also show that the distribution of eggs and larvae extends typically towards the Dutch coast and only towards the coast of England in the case of *Ammodytes*. The result of this distribution is that in March very large numbers of fish eggs and larvae occur at the same time in the Dutch coastal and off-shore waters. At one station off the Scheldt Estuary (52°07'N., 03°09'E.) over 1,600 fish eggs and larvae were caught in 3 vertical hauls of the Hensen net in 26 m. of water. Thus the competition for food of the young fish must be quite large, particularly at this time of the year when temperatures are at their minimum and the production of food for these larvae is slow. This competition between the larvae of all these species may also be expected to result in the survival rate of any one in any particular year being partly dependant on the numbers of larvae present of all the competing species. A further point of importance is the fact that these eggs are spawned in an area such that the young fish grow up along the continental coast which is the region of the southern North Sea where the small zooplankton first develop in large numbers. This is shown by Savage (1923) in his report on the macroplankton of the 1920—21 plaice-egg cruises, in the more recent surveys by the Hull workers using the plankton recorder (Rae and Rees, 1947) and in unpublished data at Hull and Lowestoft.

In the following discussion on the individual

species the emphasis is put on a comparison between the distribution in time and space of the eggs and larvae in the two years.

A. Whiting *Gadus merlangus* and Pout Whiting *G. luscus*. Charts 1—4.

Considering the two January surveys which were carried out on almost the same dates in the two years, it is seen that the largest number of eggs and larvae were found on the later survey in 1948 and the earlier one in 1947. This indicates that the peak of spawning occurred later in 1948 than in 1947.

The distribution in both years was very similar, the greatest concentration occurring on the Hinder grounds and extending north-east towards the chowen ground.

The February—March 1948 survey shows also the existence of a more northerly spawning at 3°E. and 54°N. In this more northern area only one *G. luscus* larva was caught. The northern limit of *G. luscus* larvae occurred at 53°20'N.

In the Jan. 27—Feb. 1 survey the five stations off the Hook of Holland (with values of 3, 12, 130, 9, 15), and in the February—March survey all nine stations off the Scheldt (those with the values 33, 120, 111, 30, 30, 10, 12, 12, 3) consisted of over 75% larvae while the more inshore of these stations contained only larvae. Nearly all these larvae were of *G. merlangus*. This throws emphasis on the more southern stations being the actual area of spawning.

B. Cod *Gadus callarias*. Charts 5—7.

Comparing the dates of the start of spawning in the two years, no eggs were found on the December 1947 survey and less than 10 per m². at any station in the area covered by the Jan. 7—11 1948 survey, while some eggs were found in December 1946 and up to 96 per m². were recorded on the Jan. 9—12 1947 survey. It is thus seen that spawning started considerably earlier in 1946—47 than in 1947—48.

The two areas of eggs and larvae, off the Scheldt and off Texel, were present in both years. In 1948 the survey in March extended much further north than in 1947 and showed that a little spawning occurred in a north—south lane which probably joined the Flamborough spawning area with that of the Southern Bight.

On the February—March 1948 survey all stations south of 52°10'N. showed at least as many cod larvae as cod eggs.

C. Dab *Pleuronectes limanda*. Charts 8—10.

The start of spawning occurred at about the same time in 1948 as in 1947, i.e., following the first week in January, but by the end of January

(Chart 9) the number of eggs was very much greater in 1948 than 1947. The February—March survey shows a very great spawning indeed which extends over all but the western margin of the area surveyed.

In both years the spawning was centered on the area off the Scheldt estuary. The extended March survey shows that the dab spawning area in the Southern Bight links with another one on the southern edge of the Dogger Bank.

D. Plaice *Pleuronectes platessa*. Charts 15—18.

The data are set out here for direct comparison with the other data and show that there are far more dab eggs spawned in this area than plaice, while cod and whittings produce rather less eggs in this area.

The annual egg production, timing and position of spawning of the plaice is already well known and is therefore not discussed here.

The northerly extension of plaice eggs seen on the February—March survey is probably not a regular feature. The spawning in this northern area is variable in position and quantity.

E. Flounder *Pleuronectes flesus*. Charts 23—24.

One egg each at 3 different stations was the total number of flounder eggs found on the Jan. 7—11 1948 survey, and therefore this survey has not been charted here. By the next survey, at the end of January, flounder eggs were common at the stations nearest the Belgian coast and extending north-east, some 30 miles off the Dutch coast. At the same time in 1947 the flounder eggs were not nearly so numerous.

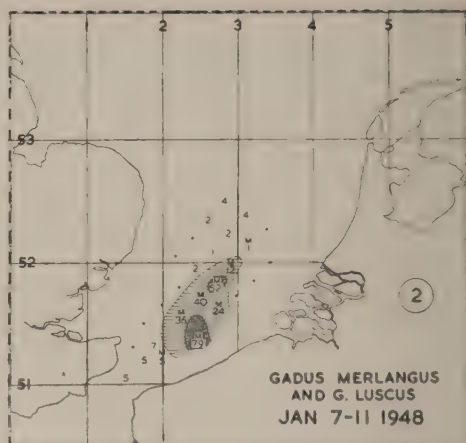
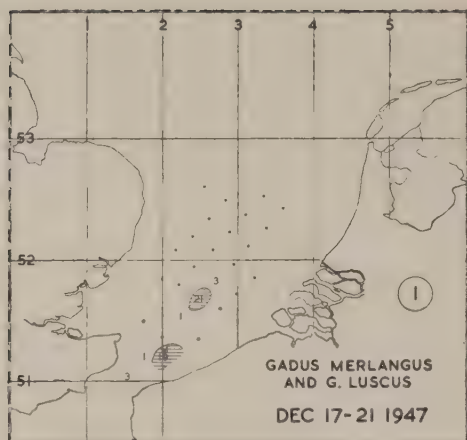
Again this year the spawning was found to be off-shore, but definitely related to the eastern side of the sea.

F. Herring *Clupea harengus*. Charts 19—22.

As in 1947, nearly all the herring larvae caught were very small, only in the last survey were there enough larvae above 11 mm. in length to change at all significantly the positions of the contours compared with the positions the contours would have held had all the larvae over 11 mm. been excluded. In the last survey the majority of the larvae in the two concentrations off the Scheldt were between 12 and 17 mm. in length.

Practically no herring larvae were found on the Dec. 17—21 1947 survey, and only by Jan. 7—11 were the numbers and distribution of the larvae comparable to those found in Dec. 27—31, 1946. Also the greatest numbers of larvae in January 1948 were present at the end of the month compared with the first half of the month in 1947. Thus it appears that the spawning of the herring in the winter 1947—48 was later than in the winter 1946—47.

Text continued on p. 97.



Legend.

Charts 1—10, 15—28.

Each number on the charts gives the total number of eggs and larvae below 1 square metre of sea surface.

Positions of stations where no eggs or larvae were found are marked by dots.

Contours are shown at 10, 50, 150, and 500 eggs and larvae below 1 m².

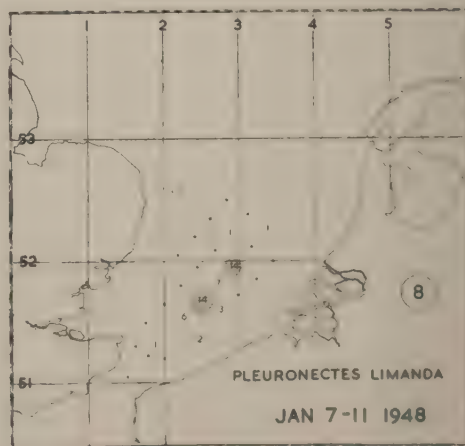
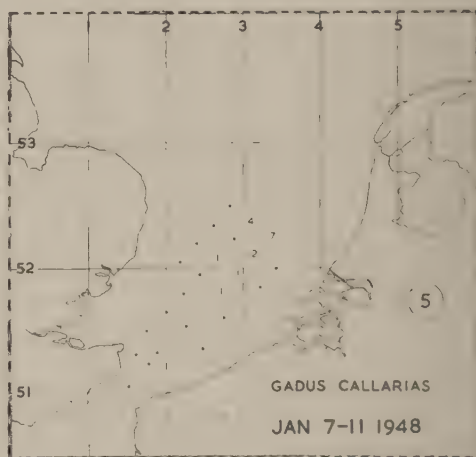
On Charts 1—4 the letters L and M show stations where larvae of *G. luscus* and *G. merlangus* respectively were present.

Charts 11—14.

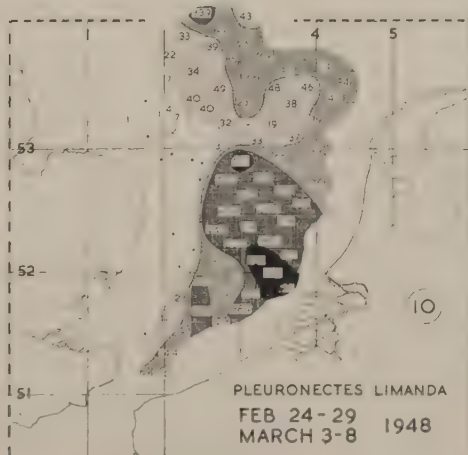
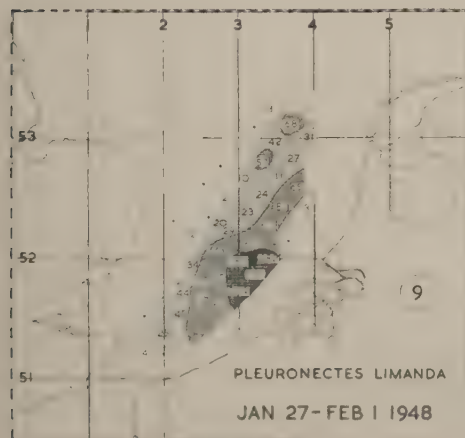
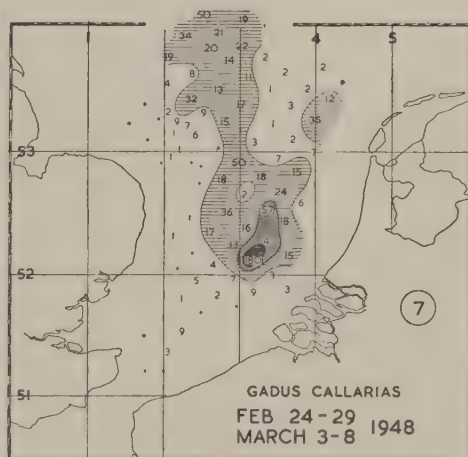
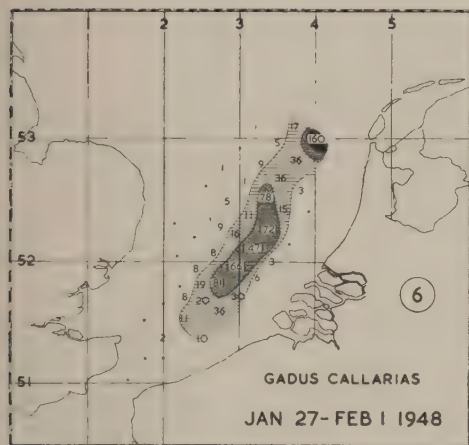
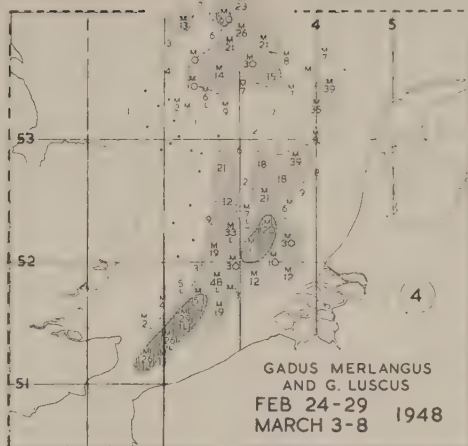
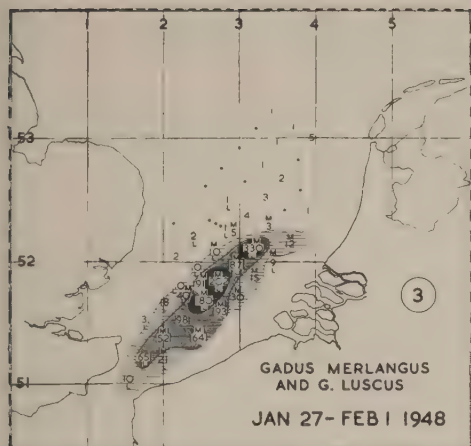
The temperatures in charts 11—14 are given in °C.

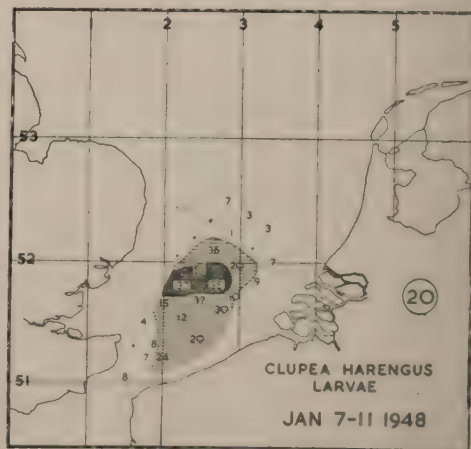
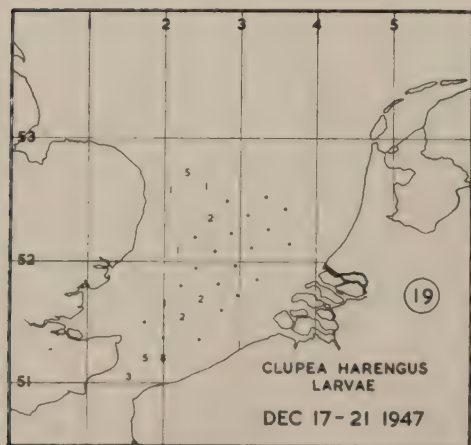
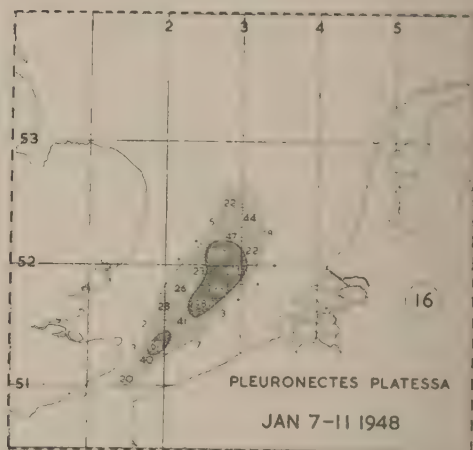
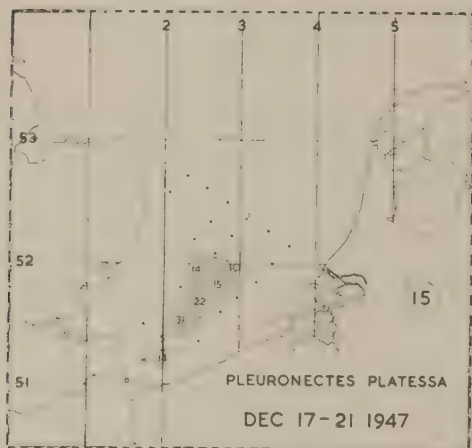
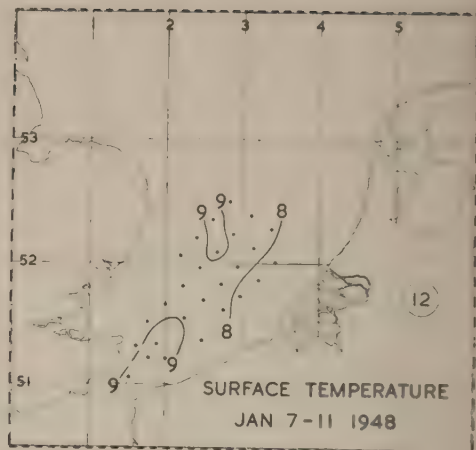
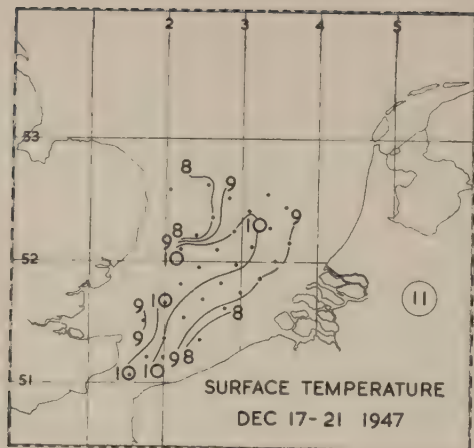
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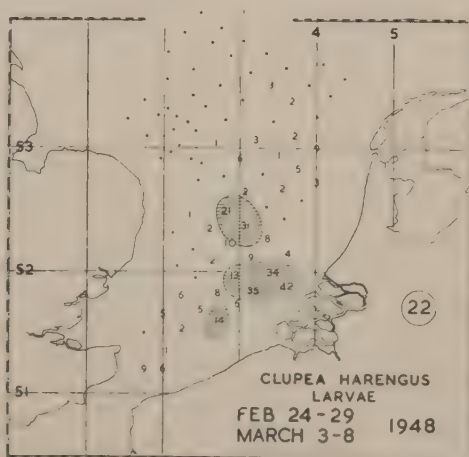
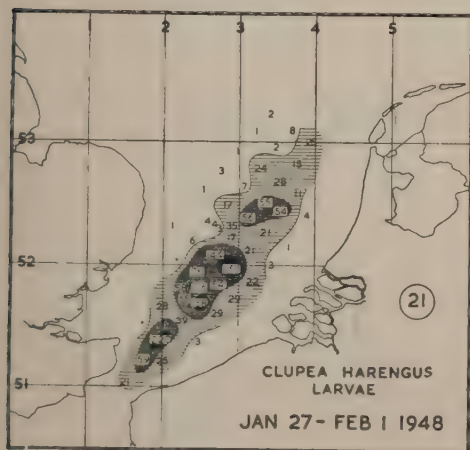
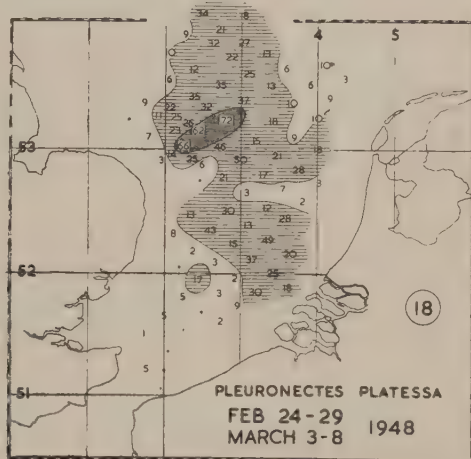
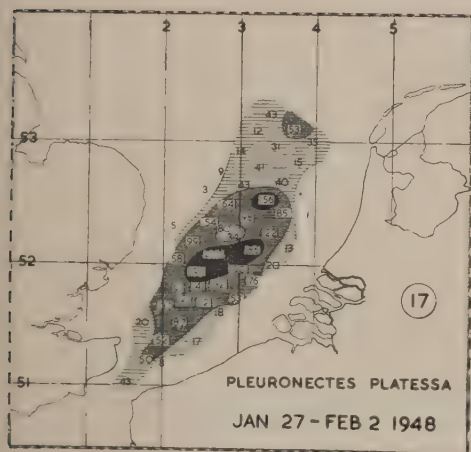
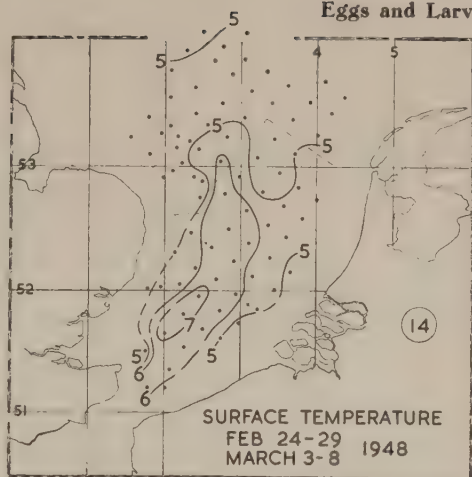
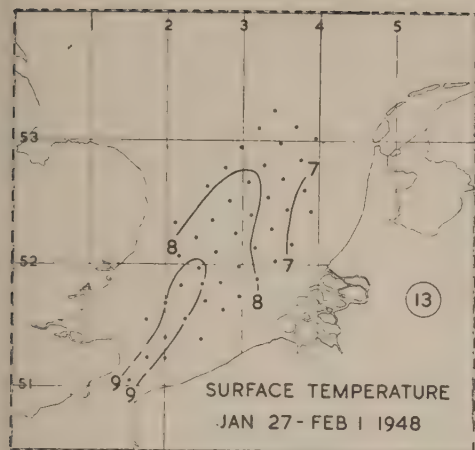
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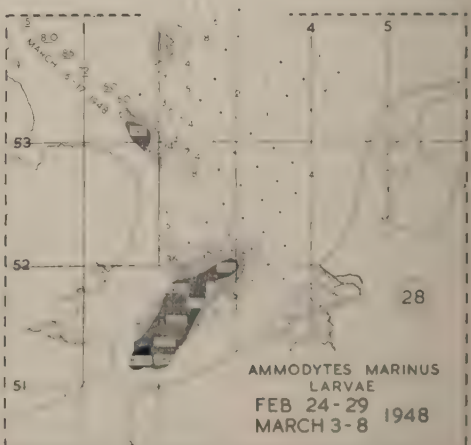
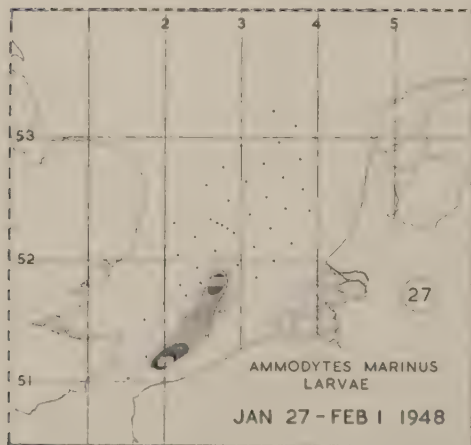
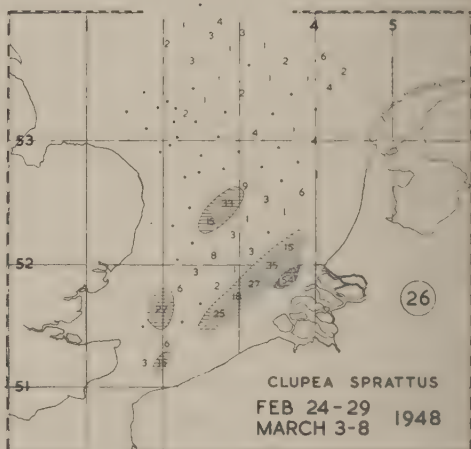
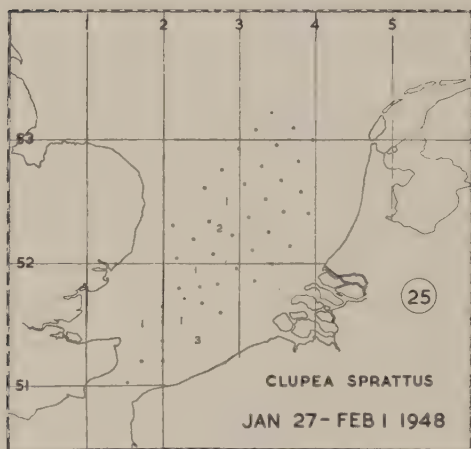
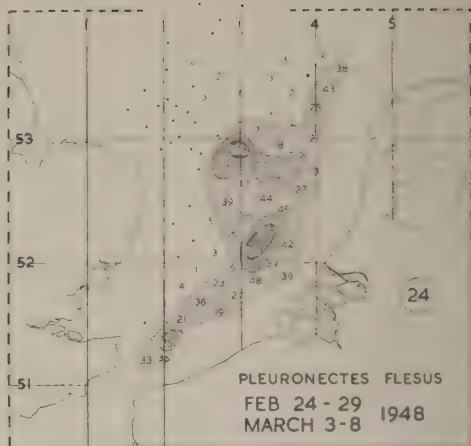
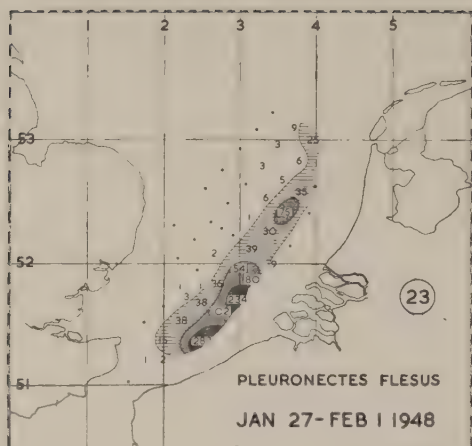


S. North Sea
Eggs and Larvae









H. Sand Eel *Ammodytes marinus* Raitt.

Charts 27, 28.

The 1948 results confirm the 1947 finding that there was an extremely sudden appearance of *Ammodytes* larvae in the southern extremity of the Southern Bight and that their distribution extended northward during February.

The tongue of larvae seen in the southern part of the February—March 1948 survey has youngest larvae on the most southern station and increasingly older larvae towards the north-east, indicating that the main spawning is towards the Straits of Dover and that the larvae are being carried north-east as they develop.

Large numbers of young larvae again were found off the north-east coast of East Anglia and also in the Dowsing area.

Six stations worked off the Humber on the 16th and 17th March gave large numbers of *Ammodytes* larvae, as shown on Chart 28 by figures which are underlined.

I. Other Species.

Small numbers of eggs and larvae of *Onos cimbrius*, *Solea vulgaris*, *Solea lutea*, *Cottus* sp. and *Callionymus* sp. were also recorded.

G. Sprat *Clupea sprattus*. Charts 25, 26.

The coastal nature of the spawning of the sprat is clearly shown by these data though it is also seen that a small amount of spawning also occurred, off-shore. Chart 26, where an area of spawning was found in water of 31 to 37 m. at 52°25'N., 0°45'E. It is also seen that small numbers of sprat eggs were present over a very wide area near the coast and in the open sea.

The Dutch Fishery for Demersal Seafish in 1948.

By

M. C. Cox-Heikens and L. K. Boerema.

WITH this paper our contributions on this subject in the previous volumes of this series are continued.

Table 1 shows the total landings and their composition at IJmuiden. The total amount landed has remained at nearly the same level as for 1947 but the landings of each species show differences. The returns of cod and haddock have decreased considerably. On the other hand the landings of nearly all flat fish have increased, partly due to an increase in the number of voyages of smaller vessels, (luggers and coastal vessels).

The figures show an increase in the landings of the smallest category of plaice and a decrease in the landings of the bigger ones.

From Table 2 can be seen that the number of days absence of the steam trawlers has increased but the quantity landed has decreased as compared with 1947. As a result the catch per days absence was much lower than in 1947 (Fig. 1).

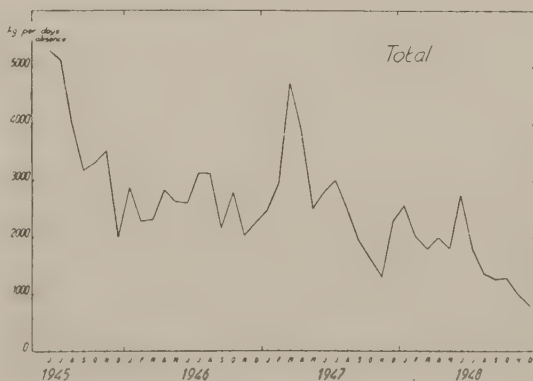


Fig. 1. Total catch per days absence by Dutch steam trawlers.

**Table 1. Quantities (in tons) of Demersal Fish landed in 1948
at the Port of IJmuiden.**

Species	Market categories	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Quantity
Brill		7.9	21.9	14.1	11.4	55.3
Cod	Large >72 cm.	512.3	649.2	203.6	123.3	1,488.4
	Medium 55—72 cm.	148.7	67.8	40.0	21.0	277.5
	Small <55 cm.	306.6	182.9	175.3	206.4	871.2
	Total	967.6	899.9	418.9	350.7	2,637.1
Dab		327.5	508.0	321.5	704.2	1,861.2
Flounder		149.7	274.9	150.6	63.0	638.2
Gurnard and Latchet		153.3	291.5	101.7	104.5	651.0
Haddock	Large >44 cm.	207.3	400.0	114.9	67.6	789.8
	Medium 30—44 cm.	690.8	678.6	565.8	411.9	2,347.1
	Small I 25—30 cm.	432.5	362.3	116.6	143.7	1,055.1
	Small II <25 cm.	3.3	0.1	—	—	3.4
	Total	1,333.9	1,441.0	797.3	623.2	4,195.4
Hake		120.4	57.1	30.7	24.2	232.4
Ling		97.7	78.0	17.4	24.4	217.5
Plaice	Large >40 cm.	189.0	220.0	173.0	86.8	668.8
	Medium 27—40 cm.	349.5	918.0	459.7	238.6	1,965.8
	Small 21—27 cm.	667.4	2,204.3	1,016.7	557.0	4,445.4
	Total	1,205.9	3,342.3	1,649.4	882.4	7,080.0
Saithe		452.7	310.6	184.9	175.3	1,123.5
Sole	Large	37.1	52.5	19.3	28.9	137.8
	Large medium	74.2	104.4	45.5	54.3	278.4
	Small medium	29.4	43.5	30.5	26.6	130.0
	Small I	13.9	26.2	20.7	12.5	73.3
	Small II	7.0	18.6	9.9	5.8	41.3
	Small III	0.5	1.0	2.2	40.0	43.7
	Total	162.1	246.2	128.1	168.1	704.5
Turbot		88.9	167.8	85.0	43.2	384.9
Whiting		751.1	678.3	506.6	761.0	2,697.0
Other Species		228.2	479.4	245.0	174.3	1,126.9
Total		6,046.9	8,796.9	4,651.2	4,109.9	23,604.9

A substantial part of the heavy decline in the catches of demersal fish per unit time in the latter part of 1948 will have been caused by the fact that the larger trawlers went trawling for herring in these months. Only the small ones kept fishing for demersal fish and the mean catching power of these vessels will be smaller than that of the whole trawler fleet. The same thing happened in 1947, but to a relatively lesser degree. Unmistakably, we see a further decline in the catches during 1948.

Rather a large number of trawlers landed their catches in England, (varying between 1 and 21 in the different months, the total number of landings

being 119). The figures of these landings have not been included in our tables.

The total catch of demersal fish landed at IJmuiden by luggers was 5,319 tons and by small vessels was 6,504 tons.

The graphs of the Figures 2–5 show the course of the catch per hundred hours fishing by steam trawlers of the different fish species. The calculations have been made in the same way as indicated in our paper in Ann. Biol. IV.

The catches of **cod** (Fig. 2) are much lower than the mean for 1947 but have remained at about the same level as they were in the second part of 1947.

Table 2. Catches of Steam Trawlers fishing from the Port of IJmuiden in 1948.

Month	No. of days absence	Quantity landed tons	Quantity per days absence kg.
January	296	758	2,563
February	460	950	2,065
March	825	1,471	1,783
April	616	1,226	1,990
May	602	1,088	1,807
June	502	1,375	2,739
July	547	990	1,809
August	244	335	1,375
September	152	194	1,275
October	184	236	1,283
November	171	174	1,016
December	50	41	819
Total year	4,649	8,838	1,901

The **haddock** (Fig. 3) shows a further decline during 1948. This is mainly caused by a continuing decrease in the catches of the smallest fish. The strong year-classes, which caused the big catches the year before, will have been fished out and have not been adequately replaced by new ones.

Figure 4 shows the course of the **plaice** fishery. In this case catches are not quite comparable with those in previous years because the boundary between the two larger market categories has been changed from 35 to 40 cm. in February 1948. The first half of the year shows an important rise in the catches of the smallest plaice. This was not continued in the second part of the year, perhaps

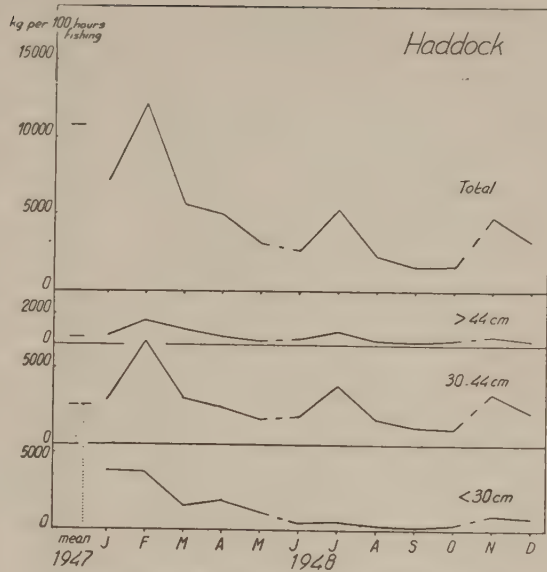


Fig. 3. Catch per 100 hours fishing. Haddock.

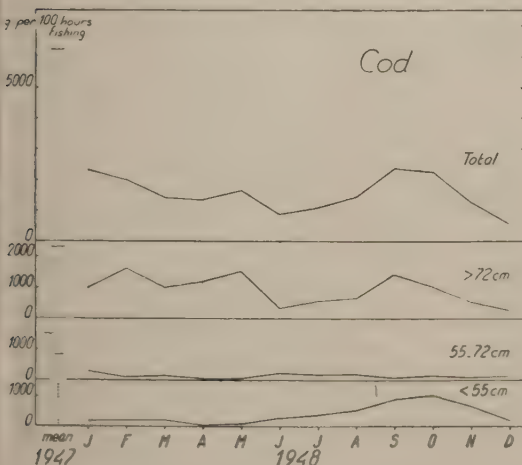


Fig. 2. Catch per 100 hours fishing. Cod.

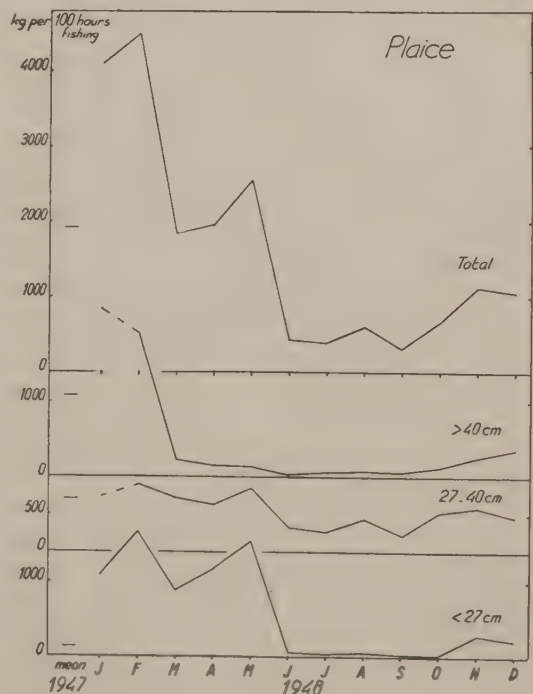


Fig. 4. Catch per 100 hours fishing. Plaice.

Table 3.
Mean Catch (in kg.) per 100 hours fishing
of Steam Trawlers at IJmuiden in 1948.

	kg.		kg.
Cod		Haddock	
> 72 cm.	908	> 44 cm.	567
55—72 cm.	154	30—44 cm.	2,664
< 55 cm.	317	< 30 cm.	1,319
Total	1,379	Total	4,559
Plaice		Sole	
> 40 cm.	472	Large and	
27—40 cm.	561	Large medium	46
21—27 cm.	598	Small medium	4
Total	1,629	Small I	6
		Small II and III	—

because of a change in the fishery. The landings by the smaller vessels indicate that throughout the whole year the stock of small plaice remained greater than during the previous year. The catches by steam trawlers of the larger plaice are below those of 1947.

The catches of soles were very poor in 1948.

The impression we get from these figures is that the stocks of cod are now beginning to reach a more or less steady level, while those of plaice and soles are still diminishing. There seems to be no definite trend in the case of the haddock.

These facts seem to be in contradiction to the figures of the total landings. We must, however, take into account that the big landings of cod in 1947 were the result of heavy catches in the first half of the year and those of haddock of the big catches of the smallest fish. Both these phenomena were exceptional, as has been put forward in our previous paper. As mentioned above, the small vessels will be partly responsible for the bigger landings of flat fish, particularly of the smallest plaice.

Table 3 gives the mean catch in kg. per hundred hours fishing, of the different fish species and categories in 1948.

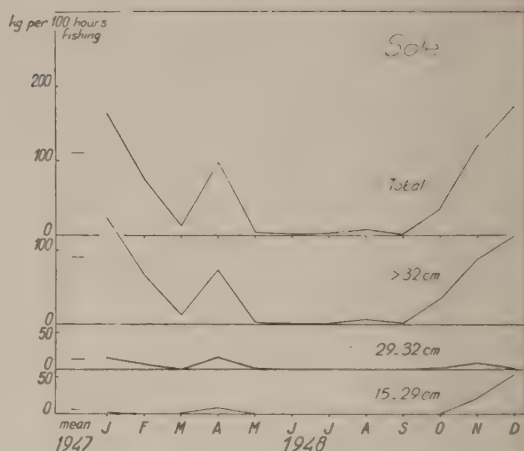


Fig. 5. Catch per 100 hours fishing. Sole.

Table 4 shows the percentage of smaller fish in the catches. Because the size boundaries between several market categories have been altered the figures are not always quite comparable with previous years. As far as possible the figures of 1947 have been recalculated with the same boundaries as for 1948.

The change in the percentage of small cod, plaice, and haddock as compared with 1947 is not an indication of a change in the fishing intensity because factors not directly related with the fishery, (severe winter, strong year-classes,) caused the high catches of small cod and haddock in 1947 and of small plaice in 1948.

The total amount landed at den Helder has risen somewhat, (Table 5,) due largely to an important increase in the landings of dabs and flounders. Most of the other species have decreased. The plaice show the same phenomenon as at IJmuiden, a rise in the smallest category and a decrease in the others. Table 4B shows the increase in the percentage of small plaice in the landings at den Helder.

Table 4. The Landings of the Class "Small" in 1948, expressed as a Percentage of the Total.

	A. At IJmuiden						B. At den Helder	
	Cod < 72 cm.	Haddock < 44 cm. < 30 cm.		Plaice < 40 cm. < 27 cm.		Sole < about 29 cm. < about 26 cm.	Plaice < 40 cm. < 27 cm.	
1st Quarter	47	85	26	84	55	13 4.6	91	68
2nd Quarter	28	71	25	93	65	19 7.9	95	68
3rd Quarter	51	98	15	89	63	26 9.5	95	71
4th Quarter	65	89	23	90	63	35 22	97	72
Total Year	44	81	25	91	63	23 12	95	70
1947	63	96	71	83	30	14 6.3	77 ¹⁾	54

¹⁾ In 1947, the limit was 35 cm.

Table 5. Quantities (in tons) of Demersal Fish landed in 1948
at the Port of den Helder.

Species	Market categories	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Quantity
Brill		0.8	5.5	4.8	2.7	13.8
Cod		3.7	1.1	0.4	14.2	19.4
Dab		80.3	83.4	44.2	260.5	468.4
Flounder		49.2	47.5	55.3	35.5	187.5
Plaice	Large >40 cm.	12.3	22.6	15.4	5.6	55.9
	Medium 27—40 cm.	32.0	107.5	75.8	56.0	271.3
	Small 21—27 cm.	94.8	277.2	218.4	163.4	753.8
Total		139.1	407.3	309.6	225.0	1,081.0
Sole		16.9	63.9	28.5	29.5	138.8
Turbot		2.2	7.6	4.6	2.5	16.9
Whiting		67.1	21.9	9.7	51.3	150.0
Other species		0.1	28.8	7.8	3.1	39.8
Total		359.4	667.0	464.9	624.3	2,115.6

The Danish Plaice Fishery in the North Sea.

By

Aage J. C. Jensen.

THE market investigations at Esbjerg carried out from Dr. Tåning's department of "Kommissionen for Danmarks Fiskeri- og Havundersøgelser" have been continued in March, May, June, August, September, and November 1948.

Density of the Stock.

The decrease in density recorded in the first post-war years has ceased and even a minor improvement has occurred at most of the fishing grounds during recent years (see Table 1). We may assume that this is due to an improved growth at the nursery grounds of the youngest plaice (see below), and consequently a better recruitment of the stock of commercial plaice.

Length Composition of the Catches.

From 1946 to 1948 the length of the plaice in the catches had decreased in all areas up to 40 m. depth, i.e., on the nursery grounds off the North-Frisian islands (A 3 and B 4) and the Dogger, but it remained unaltered or was even a little higher in deeper waters (C 2 and northern edge of the Dogger) (see Table 2).

It may be noted that in June and July 1946 the length of the plaice caught at 15—20 m. depth off the North-Frisian islands was very small. Normally the small plaice from the coastal zone will spread over this area during the first summer months, and in 1946 the effect of this spreading has been very marked, which can be explained by the dense stock of very slow-growing small plaice near to the coast (see Tåning, Ann. Biol. II, p. 53—54).

Table 1. Mean Weight per Landing

(in brackets: number of landings).

	1946 Apr.-June	1947 March-Oct.	1948 Sept.
B 4	3.3 (3)	—	3.5 (7)
C 2, north-eastern ¹⁾	4.2 (3)	3.3 (9)	3.6 (3)
Dogger Bank	1.6 (4)	2.0 (2)	2.2 (8)
Northern edge of Dogger	6.4 (5)	3.8 (2)	2.7 (2)

¹⁾ At depths beyond 40 m. between 55° and 56°N. Lat. and east of 5°E. Long.

Table 2. Length Composition of Catches (%).

Area	A 3, Horns Reef-Helgoland			B 4		C 2, N.E.			Dogger			N. edge of Dogger	
Year	1946		1948	1946	1948	1946	1947	1948	1946	1947	1948	1946	1948
Month	May	June	May-June	April-July	June-Aug.	July-Oct.	Oct.	June	April-July	Oct.	Aug.	June	Aug.
Depth, m.	18-19	19	19-20	34-40	35-36	45-47	40-60	45-50	25-40	29	21-36	50-55	58-65
No. of catches	2	1	4	5	2	9	9	2	8	1	7	2	2
cm.-group													
27—30	20	69	72	12	56	48	46	37	3	32	34	—	2
31—35	47	29	28	38	40	38	40	39	25	62	39	9	10
36—40	21	2	—	36	2	12	11	13	37	4	20	28	22
41—45	6	—	—	10	1	2	2	8	24	1	4	30	32
46—50	3	—	—	3	1	0.3	1	2	9	0.4	2	13	17
51—55	3	—	—	0.4	0.2	—	0.2	1	2	0.1	1	11	12
56—60	—	—	—	0.4	—	—	—	0.3	0.3	—	0.1	9	5
61—65	—	—	—	0.3	—	—	—	—	—	—	—	—	—

In 1948, from June to August, a similar decrease in the length of plaice was not found, but contrary to 1946, the length had increased about as much as might be expected from the growth. Thus we may suppose that the overcrowding of small plaice at the coast is now considerably less than during the preceding years.

Age Composition of Catches and Length of Age-Groups.

The decrease in length at the lesser depths is mainly due to the fact that in 1948 the plaice were

younger than in 1946, but also that they were smaller at the same age (see Table 3).

The old plaice which in the first post-war years were relatively frequent on many grounds have now been fished and have been replaced by younger fish. The fishing is now so intensive that a very great part of the fastest growing plaice are removed from the stock of commercial plaice soon after they have reached the minimum size, and therefore the length of each age-group has decreased.

Table 3. Age Composition of Plaice above 27.0 cm. (%), and Length of V-Group (in cm.).

(In brackets number of plaice of the V-group).

Area	A 3		N.W. of White Bk.		Clay Deep		Tail End	
Year	1946	1948	1946	1948	1946	1948	1946	1948
Month	May	June	July	Aug.	May	June	May	June
Depth, m.	19	20	35	37	39	37	45	39
II	1	—	—	—	—	—	—	—
III	4	36	1	47	—	1	—	41
IV	15	43	4	37	—	38	—	41
V	56	17	29	16	53	20	41	14
VI	20	4	32	—	29	18	32	3
VII	1	0.2	14	—	7	7	23	0.6
VIII	1	0.2	9	—	7	3	4	—
IX	—	—	6	—	4	1	—	—
X	1	—	4	—	—	1	—	—
XI	—	—	—	—	—	1	—	—
XII	—	—	1	—	—	—	—	—
XIII	1	—	—	—	—	—	—	—
Length of V-group	33.8 (118)	31.4 (69)	39.8 (41)	32.5 (31)	34.6 (15)	35.6 (60)	36.6 (9)	31.6 (51)

The English Plaice Fishery in the Southern North Sea and English Channel in 1948.

By

R. S. Wimpenny.

INFORMATION concerning the English plaice fishery in the southern North Sea and from the Rye Bay district of the English Channel continued to be collected in 1948 and some of the essential figures are produced in the following note.

Size.

Of the size frequencies resulting from measurements made at Grimsby, Lowestoft and Rye Bay markets, it has been thought useful to display those for the quarters or taken at quarterly intervals (Rye Bay), as numbers per hundred hours fishing, or in the case of Rye Bay per hundred hours absence from port (Figures 1 and 2). The areas referred to are Rye Bay and the two sets of North Sea rectangles dealt with in former volumes of *Annales Biologiques*. Data from 1947 are reproduced in a similar form for the purpose of comparison.

In Rye Bay the length distributions of the winter quarter stock spread over a wide range including maxima between 41 and 43 cm. corresponding to last year's distribution of large fish and a range of small individuals between 26 and 30 cm. As usual, the large fish were virtually absent at the next three quarters, fish with a mode of 26—28 cm. and a similar abundance being characteristic. It should be noted that there has been no tendency towards an increasing abundance of smaller fish during the

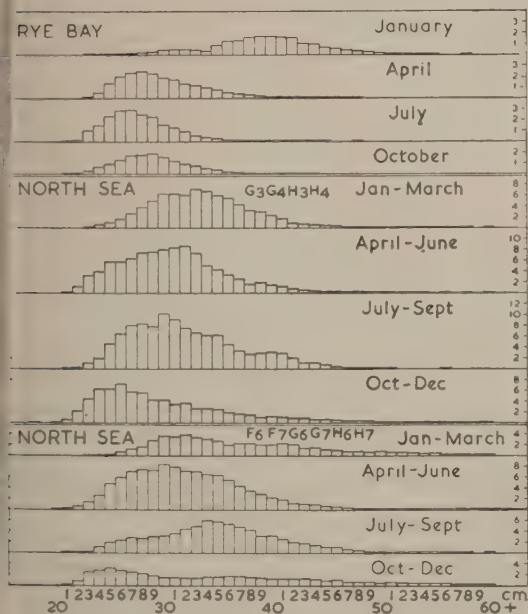


Fig. 1. 1947.

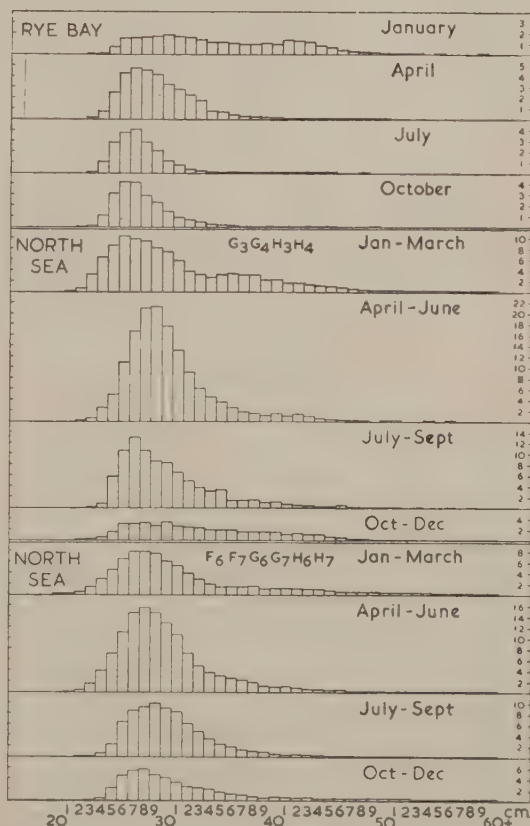


Fig. 2. 1948.

Frequency histograms showing the length distribution of plaice per 100 hours absence for Rye Bay and per 100 hours fishing for two areas of the North Sea for each quarter of the year. The ordinates are marked in 100's for Rye Bay and in 200's for the North Sea Areas.

Table 1. Rye Bay Plaice.

Age Composition of Rye Bay Plaice in 1948, for males, females and both sexes, by numbers and $\bar{S}(L)$ with respect to average length, $\bar{S}(L)$, average weight, number of fish examined, estimated weight (cwt.), estimated numbers and estimated catch per 100 hours absence from port by weight and numbers.

Age-Group		I	II	III	IV	V	VI	VII	VIII	IX+	Total
No. of fish examined	♂	22	210	137	75	33	3	3	3	—	486
	♀	26	203	123	98	38	8	6	5	16	523
	Total	48	413	260	173	71	11	9	8	16	1,009
Percentage	♂	4.5	43.2	28.2	15.5	6.8	0.6	0.6	0.6	—	—
	♀	5.0	38.8	23.5	18.7	7.3	1.5	1.1	1.0	3.1	—
	Total	4.8	40.9	25.8	17.1	7.0	1.1	0.9	0.8	1.6	—
Estimated No. of fish landed (000's omitted)	♂	35	342	319	206	84	8	6	10	—	1,010
	♀	30	339	259	264	115	20	18	17	55	1,117
	Total	65	681	578	470	199	28	24	27	55	2,127
Estimated weight (cwt.)	♂	132	1379	1333	858	361	54	30	70	—	4,217
	♀	106	1455	1338	1403	650	148	139	215	761	6,215
	Total	238	2834	2671	2261	1011	202	169	285	761	10,432
Estimated catch per 100 hours absence	{ (cwt.) Total	0.4	4.3	4.0	3.3	1.6	0.3	0.2	0.4	1.0	15.5
	{ (No.) Total	94	1021	862	687	311	38	34	37	74	3,158
Average weight (g.)	♂	195	204	222	219	220	366	255	347	—	—
	♀	186	222	276	288	300	375	383	638	—	—
	Total	190	213	247	258	263	373	341	529	—	—
Average length (cm.)	♂	27.0	27.3	28.4	29.0	29.0	35.2	31.2	34.8	—	—
	♀	26.3	27.9	30.1	30.9	31.4	34.0	35.3	43.1	—	—
	Total	26.6	27.6	29.2	30.1	30.3	34.3	33.9	40.0	—	—
$\bar{S}(L)$	♂	2.17	2.41	2.75	2.63	2.65	—	—	—	—	—
	♀	1.41	2.70	3.16	3.29	2.91	—	—	—	—	—
	Total	1.82	2.57	3.07	3.16	3.04	5.55	3.81	5.21	—	—

course of the year, as was the case in the period 1943—1946.

Plaice in the two North Sea areas were mainly between 26 and 30 cm. In the southern area there was a sharp increase in size between the first and second quarter, and in spite of a recession in the third quarter, size had increased slightly by the end of the year. In the northern area there was a small relative and absolute decrease in the number of very small fish in the last two quarters, otherwise size distribution showed little change. These conditions may be observed to contrast with the previous year when smaller fish appeared later in the year. Taking the last two years together it appears that during the last two quarters of 1947 and the first two quarters of 1948 there was a recruitment of smaller fish which fell off after the middle of 1948. This recruitment would be quite apart from the immigration into the areas of any fish of larger size such as may have taken place between the first and second quarters of 1948 in the southern area.

Age-Composition.

The 1948 data on age-composition for Rye Bay, the two North Sea areas, and for the Lowestoft and Grimsby landings appear in Tables 1, 2, 3 and 4. In Figure 3 I have given the age-distribution per 100 hours fishing for the different areas in 1948, and in Figure 4 the age-distribution for the estimated number landed in 1000s for the Rye Bay and Lowestoft and Grimsby landings in respect of 1946, 1947 and 1948.

It is seen that in Rye Bay the catch included a II-group a little more numerous than that of last year, and that this dominant group is supported by substantially greater numbers of III and IV-group fish than were caught in the previous year. This has resulted in a more numerous total catch than in 1947 and, as will be seen in a later section, a bigger catch per hour's absence.

The III-group, which consists largely of the 1945 year-class, represents the most numerous group in the catch from the southernmost of the

Table 2. Plaice from Statistical Rectangles G 3, G 4 — H 3, H 4. (All Trawlers).
 Age Composition by numbers and percentage in 1948 with respect to average length, S(L),
 average weight, raised numbers, raised weight, and catch per 100 hours fishing.

Age-Group		II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
No. of fish examined	♂	22	216	219	142	39	25	32	9	10	6	2	722
	♀	12	242	206	148	33	17	24	30	18	24	27	781
	Total	34	458	425	290	72	42	56	39	28	30	29	1,503
Percentage	♂	3.1	29.9	30.3	19.7	5.4	3.5	4.4	1.2	1.4	0.8	0.3	—
	♀	1.5	31.0	26.4	18.9	4.2	2.2	3.1	3.8	2.3	3.1	3.5	—
	Total	2.2	30.5	28.3	19.3	4.8	2.8	3.7	2.6	1.9	2.0	1.9	—
Estimated No. of fish landed (000's omitted)	♂	135	1,087	1,124	667	231	156	188	46	72	42	12	3,760
	♀	79	1,254	929	689	145	74	148	199	119	139	152	3,927
	Total	214	2,341	2,053	1,356	376	230	336	245	191	181	164	7,687
Estimated weight (cwt.)	♂	416	4,099	4,965	3,471	1,727	1,381	1,572	434	745	433	101	19,344
	♀	257	4,660	4,416	3,948	1,179	751	2,151	2,922	1,805	2,241	3,007	27,337
	Total	673	8,759	9,381	9,419	2,906	2,132	3,723	3,356	2,550	2,674	3,108	46,681
Catch per 100 hours fishing (cwt.)	♂	0.5	5.0	6.1	4.3	2.1	1.7	1.9	0.5	0.9	0.5	0.1	23.6
	♀	0.3	5.7	5.4	4.9	1.5	0.9	2.6	3.6	2.2	2.8	3.7	33.6
	Total	0.8	10.7	11.5	9.2	3.6	2.6	4.5	4.1	3.1	3.3	3.8	57.2
(No.)	"	264	2,883	2,528	1,670	463	283	413	301	235	223	202	9,465
Average weight (g.)	♂	157	195	223	259	365	445	425	462	542	527	—	—
	♀	176	198	246	294	373	479	731	753	764	803	—	—
	Total	164	197	234	277	369	459	556	686	685	748	—	—
Average length (cm.)	♂	26.4	27.4	28.9	30.2	34.1	36.6	37.1	37.2	39.2	39.8	—	—
	♀	26.3	27.4	29.5	31.4	34.0	37.2	42.4	42.0	43.8	44.4	—	—
	Total	26.4	27.4	29.2	30.8	34.0	36.8	39.4	40.9	42.2	43.5	—	—
S(L)	♂	1.78	2.09	2.34	3.16	4.34	3.48	3.03	3.35	4.55	4.80	—	—
	♀	1.27	2.00	2.42	3.15	4.31	4.26	3.00	3.72	2.93	3.81	—	—
	Total	1.60	2.04	2.40	3.21	4.30	3.77	3.98	4.15	4.17	4.34	—	—

North Sea areas. It will be recalled that it was the II-group, chiefly composed of the 1945 year-class that was dominant in the fishery of this area last year. The IV and V-groups are also of substantial importance in the southernmost area, but the older groups have fallen off sharply in importance. The IV-group (mainly 1944 brood) although not quite so numerous as the III-group makes the biggest weight contribution to the year's catch.

In the more northern area the IV-group is dominant in both weight and numbers, representing about a quarter of the total from the former and a third for the latter. It is followed in importance by the III-group and the V-group, these three classes constituting over half the weight of the catch.

The distribution of the year-classes for the total Grimsby and Lowestoft steam trawler landings is similar to the northern area.

Average Length of Age-Groups.

The mean lengths of the age-groups from the different areas have much the same relation to each other that has been found in previous years, the largest fish in the older age-groups coming from the northernmost of the North Sea areas, and the largest of the first three age-groups coming from the inshore grounds of Rye Bay. Compared with last year (Table 1) and excepting the I-group, the lengths of the Rye Bay fish were lower, whereas in the southernmost of the North Sea areas lengths were higher outside the IV to VII-groups where they remained nearly the same (Table 2). In the northernmost of the North Sea areas lengths were similar in the two years up to V-group, but thereafter were increasingly higher in 1948, (Table 3). A similar picture of greater lengths in the North Sea areas and smaller ones in the Rye Bay fishery

**Table 3. Plaice from Statistical Rectangles F6, F7 — G6, G7 — H6, H7.
(All Trawlers)**

Age Composition by numbers and percentage in 1948 with respect to average length, S(L), average weight, raised numbers, raised weight, and catch per 100 hours fishing.

Age-Group		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
No. of fish examined	♂	—	55	465	590	268	95	67	27	9	11	5	5	1,597
	♀	2	60	501	526	256	81	50	61	43	44	26	43	1,693
	Total	2	115	966	1,116	524	176	117	88	52	55	31	48	3,290
Percentage	♂	—	3.4	29.1	36.9	16.8	6.0	4.2	1.7	0.6	0.7	0.3	0.3	
	♀	0.1	3.6	29.6	31.1	15.1	4.8	3.0	3.6	2.5	2.6	1.5	2.5	
	Total	0.1	3.5	29.4	33.9	15.9	5.3	3.5	2.7	1.6	1.7	0.9	1.5	
Estimated No. of fish landed (000's omitted)	♂	—	278	2,594	3,653	1,758	632	454	185	48	54	25	34	9,715
	♀	9	295	2,801	3,310	1,627	520	348	357	259	290	153	265	10,234
	Total	9	573	5,395	6,963	3,385	1,152	802	542	307	344	178	299	19,949
Estimated weight (cwt.)	♂	—	942	11,009	16,578	9,754	4,610	4,352	1,876	651	734	233	395	51,134
	♀	23	1,071	12,562	16,745	10,460	4,422	3,795	5,882	5,373	5,621	3,606	7,269	76,829
	Total	23	2,013	23,571	33,323	20,214	9,032	8,147	7,758	6,024	6,355	3,839	7,664	127,963
Catch pr. 100 hours fishing (cwt.)	♂	—	0.4	4.7	7.1	4.2	2.0	1.9	0.8	0.3	0.3	0.1	0.2	22.0
	♀	0.0	0.5	5.4	7.2	4.5	1.9	1.6	2.5	2.3	2.4	1.5	3.1	32.9
	Total	0.0	0.9	10.1	14.3	8.7	3.9	3.5	3.3	2.6	2.7	1.6	3.3	54.9
(No.)	♂	4	246	2,319	2,992	1,455	495	345	233	132	148	76	129	8,574
	♀	125	183	230	269	339	450	588	856	1,081	1,037	1,219	—	—
	Total	125	178	224	254	314	413	540	752	1,013	964	1,098	—	—
Average length (cm.)	♂	—	26.2	28.1	29.3	31.4	34.4	38.0	38.8	40.3	41.7	38.1	—	—
	♀	24.0	26.8	28.7	30.3	32.7	35.8	39.1	44.4	47.0	46.8	48.9	—	—
	Total	24.0	26.5	28.4	29.8	32.0	35.0	38.5	42.7	45.9	45.8	47.1	—	—
S(L)	♂	—	2.06	2.38	2.95	3.42	3.80	3.71	2.84	3.53	3.92	3.05	—	—
	♀	—	2.04	2.37	2.92	3.40	4.80	4.93	4.33	4.87	5.44	5.79	—	—
	Total	—	2.06	2.39	2.98	3.47	4.34	4.29	4.69	5.31	5.53	6.74	—	—

when 1948 is compared with 1947 is shown by the measurements of female fish.

Average Weight of Age-Groups.

The mean weights of the age-groups from the different areas are shown in Tables 1, 2 and 3. Their relation to each other resembles the position in 1947. The Rye Bay fish, however, were lighter at all stages than they had been in that year. In the southernmost North Sea areas samples of the 1948 fish were also lighter from age-group VII onwards, but below this age-group and for all age-groups of the northernmost North Sea area except VI, VII and X, the values were similar in both years. In the excepted age-groups the 1948 weights were less.

Fishing Effort.

In 1948 the 1st-class trawlers including both steam and motor vessels working at Grimsby and

fishing in the North Sea may be estimated at 146, having declined during the year from 176 in January to 116 in December. The number of vessels working was, therefore, less than the previous year. At Lowestoft the average for these vessels was 72, again a decrease on last year.

For 1946 and 1947 estimates of the crews of trawlers have been applied to the landings of 1st-class steam trawlers in order to get an estimate of the catch per man. As is shown in Table 5, however, there has been a progressive increase in the importance of motor trawler landings and the estimated catch per trawlerman should properly be made to take this into account. The catch, fishing time, catch per hundred hours and estimated number of plaice caught by 1st-class steam and motor trawlers at Grimsby and Lowestoft have therefore been related to the estimated number of trawlermen at work and the catch per trawlerman. These give the following revised figures for 1946 to 1947 to compare with 1948.

Table 4. Commercial Landings at Lowestoft and Grimsby 1948 (Steam Trawlers).

Age Composition by numbers and percentage, average length, S(L),
average weight, raised numbers, raised weight, and catch per 100 hours fishing.

Age-Group	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
Fish examined	3	428	3,057	3,161	1,807	591	359	305	220	185	142	184	10,442
Average	0.0	4.1	29.3	30.3	17.3	5.6	3.4	2.9	2.1	1.8	1.4	1.8	—
Total No. of fish landed (omitted)	13	2,371	14,668	14,933	8,506	2,678	1,639	1,513	1,165	804	684	858	49,832
Total weight (cwt.)	34	7,357	60,590	74,857	53,908	21,336	18,104	19,953	20,145	13,911	12,565	18,919	321,679
Catch per 100 hours (cwt.)	0.0	1.2	10.0	12.3	8.9	3.5	3.0	3.3	3.3	2.3	2.1	3.1	53.0
Number (cwt.)	2	390	2,412	2,456	1,399	440	270	249	192	132	112	141	8,195
Average weight (g.)	132	165	214	262	325	406	529	650	776	843	890	—	—
Average length (cm.)	24.5	26.1	28.1	30.1	32.3	34.9	38.2	41.0	43.1	44.9	45.2	—	—
Standard deviation	—	2.13	2.40	3.02	3.57	4.14	4.47	4.71	4.68	4.79	5.43	—	—

	1946	1947	1948
Catch of first-class steam and motor trawlers (cwt.)	473,718	402,234	369,053
Hours fishing	545,720	621,208	692,771
Catch per 100 hrs. fishing (cwt.)	86.8	64.8	53.3
Estimated numbers of plaice caught (millions)	56.98	58.63	57.12
Estimated number of men employed	2,130	2,400	2,108
Estimated catch per man (cwt.)	222.4	167.6	175.1

The hours fishing, the catch per hundred hours fishing and the total catch of plaice shown separately for 1st-class steam and motor trawlers appear in Table 5. It is clear from this that there has been an increase in the time spent fishing accompanied by a fall in the catch per 100 hours fishing at both ports from 1947 to 1948, the fall in the catch per hour being greater at Lowestoft. Motor trawlers, it appears, were more efficient than steamers in catching plaice. The table also shows the even greater efficiency of steam and motor seiners, motors again being much superior to steamers. In the case of the seiners it is to be noted that the catch per 100 hours was actually higher in 1948 than in 1947.

Fishing effort also increased in the Rye Bay ports, there being 5,021 fishing trips (Table 6) and 53,115 hours absence from port (Table 7) in 1948,

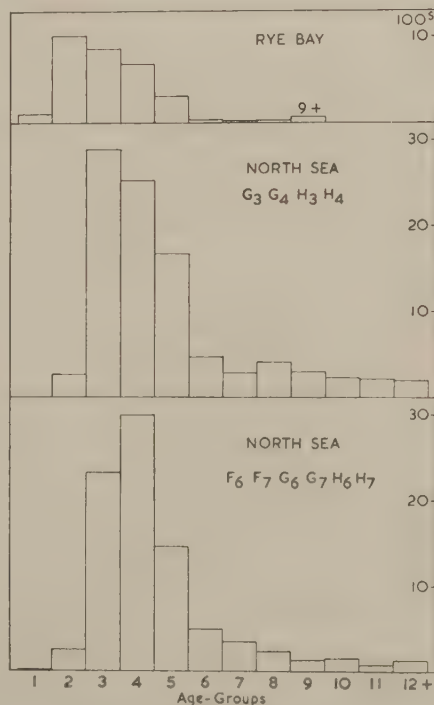


Fig. 3. Age-distribution in catch per 100 hours absence from port for Rye Bay and catch per 100 hours fishing for two areas of the North Sea in 1948.

Table 5. Landings (in cwt.) of North Sea Plaice at Lowestoft and Grimsby by 1st-Class Steam and Motor Trawl and 1st-Class Steam and Motor Seine for the Years 1938, 1946, 1947 and 1948.

Year	Method	Lowestoft			Grimsby			Lowestoft and Grimsby		
		Total landings 000's omitted	100 hours fishing	Catch per 100 hours	Total landings 000's omitted	100 hours fishing	Catch per 100 hours	Total landings 000's omitted	100 hours fishing	Catch per 100 hours
1938	Steam Trawl	38	1239	30.3	186	8405	22.2	224	9645	23.2
	Motor Trawl	10	801	12.2	2	111	15.8	11	911	12.6
	Steam Seine	—	—	—	3	208	14.1	3	208	14.1
	Motor Seine	—	—	—	4	139	29.8	4	139	29.8
1946	Steam Trawl	145	1703	84.9	313	3498	89.4	458	5201	88.0
	Motor Trawl	16	248	63.8	0.3	7	44.7	16	256	63.2
	Steam Seine	3	32	81.6	8	74	113.8	11	106	104.0
	Motor Seine	—	—	—	19	138	139.3	19	138	139.3
1947	Steam Trawl	159	1976	80.3	206	3680	56.1	365	5657	64.6
	Motor Trawl	29	416	68.8	8	139	60.5	37	555	66.7
	Steam Seine	—	—	—	9	93	99.9	9	93	99.9
	Motor Seine	—	—	—	40	236	168.0	40	236	168.0
1948	Steam Trawl	116	2045	56.9	205	4035	50.9	322	6081	52.9
	Motor Trawl	32	560	56.9	16	287	54.1	47	847	55.9
	Steam Seine	—	—	—	7	59	113.1	7	59	113.1
	Motor Seine	—	—	—	75	445	168.9	75	445	168.9

compared with 4,886 fishing trips and 52,165 hours absence from port the year before. While the catch per 100 hours fishing in 1948 was 82 0/10 of the 1947 figure for all trawlers at Grimsby and Lowestoft, in Rye Bay the petrol and paraffin driven trawlers showed an increase in their catch per 100 hours absence from port of 29 0/10 — 11.9 to 15.4 cwt. (Table 7). The 113 men estimated to have been engaged in these Rye Bay trawlers are calculated to have caught 2.1 million plaice, and to have landed 93 cwt. per head this year compared with 77 cwt. in 1947.

Commercial Landings.

The catch of Lowestoft and Grimsby 1st-class steam trawlers, which was the only figure dealt with in the two preceding reports showed a further decline of over 43,000 cwt. when compared with 1948, but still remains at 321,679 cwt., nearly 100,000 cwt. above the 1938 level.

Table 5 shows that the drop in the catch of the 1st-class steam trawlers was chiefly attributable to

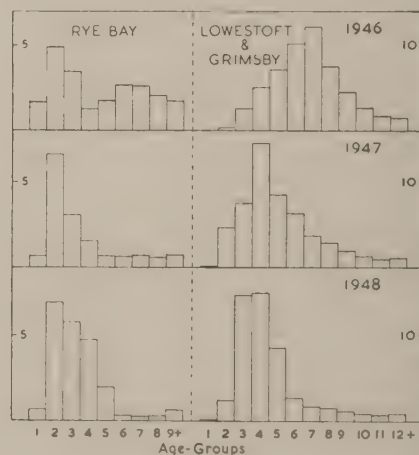


Fig. 4. Age-distribution by total numbers landed in 100,000's at Rye Bay ports and in 1,000,000's at Lowestoft and Grimsby for 1946, 1947 and 1948.

Table 6.

Number of Fishing Trips made by petrol and paraffin driven Motor Trawlers working from Rye Bay Fishing Stations (Hastings, Rye, Dungeness).

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1948	122	325	743	723	697	515	428	412	357	412	191	86

a fall in the Lowestoft landings, the decline at Grimsby being slight. 1st-class motor trawler landings on the other hand have increased at both ports, the increase being due to more fishing time, not the catch rate which has fallen. An interesting feature of the landings is the nearly doubled catch by the Grimsby motor seiners, an increase which has not been accompanied by any fall in the catch per 100 hours fishing.

Table 7.

Plaice Catch per 100 Hours Absence
and total Plaice Catch for petrol and paraffin driven
Motor Trawlers of Rye Bay Fishing Stations.

Months	1947		1948	
	Catch per 100 hours absence	Catch (cwt.)	Catch per 100 hours absence	Catch (cwt.)
I	21.3	399	16.1	198
II	22.4	604	27.3	935
III	21.3	756	19.5	1,506
IV	15.4	979	16.6	1,247
V	9.8	745	17.1	1,272
VI	8.3	413	20.4	1,137
VII	10.0	521	10.4	455
VIII	11.5	690	7.9	323
IX	7.4	401	7.6	282
X	8.1	433	9.1	411
XI	8.5	146	13.1	343
XII	8.4	124	9.7	89
Total	11.9	6,211	15.4	8,198

The effect of the increased importance and success of motor seiners has been to make the total landings of plaice from all 1st-class vessels working out of Grimsby and Lowestoft little short of that for last year, 430,840 cwt. compared with 431,158 cwt.

The drop in the total landings of plaice by the Rye Bay trawlers which occurred between 1946 and 1947 was reversed in 1948 when the figure rose to 10,432 cwt. from 8,438 cwt. (Tables 1 and 8). Sorting into size categories ceased at Hastings in October.

Table 8.

Landings of Plaice at Hastings in cwt.
(percentage in brackets) and below, (a) Plaice
(b) all Demersal Fish at Rye Bay Ports 1948.

	Large	Medium	Small
January	27 (16)	99 (59)	43 (25)
February	106 (14)	454 (59)	203 (27)
March	90 (12)	443 (58)	224 (30)
April	66 (11)	343 (58)	183 (31)
May	64 (13)	294 (60)	130 (27)
June	46 (10)	300 (62)	136 (28)
July	46 (15)	179 (59)	77 (26)
August	65 (26)	147 (58)	42 (16)
September	64 (25)	157 (60)	39 (15)
October		289	
November		337	unsorted
December		97	
(a) 10,432.	(b) 12,206.		

La Pêcherie et la Biologie des Concentrations Annuelles des Harengs Guais sur les Côtes Belges et Françaises, 1947—48.

Par

Ch. Gilis.

A. Pêcherie.

1. Lieu et Epoque de Pêche.

La campagne de harengs guais 1947—48, débuta le 4 Décembre 1947 et elle se prolongea jusqu'au 6 Mars 1948.

C'est devant Nieuport, notamment dans le "West-Diep" que les premiers harengs guais firent leur apparition. A ce moment les bancs étaient

encore épars et les captures minimes. Aussi ce n'est qu'au cours de la deuxième quinzaine de Décembre 1947 que les prises devinrent plus ou moins abondantes.

Du début de la campagne jusqu'au 15 Janvier les bancs de harengs guais furent les plus denses près de la côte Belge, entre Nieuport et Blankenberghe et tant à l'intérieur des eaux territoriales qu'à proximité de la limite.

Tableau 1. Récapitulation des résultats enregistrés au cours de la campagne de harengs guais 1947—48.

Details	Décembre	Résultats mensuels		Mars	Résultats saisonniers
		Janvier	Février		
Nombre de bateaux	175	177	145	31	243
Nombre de pêches	677	1,057	413	43	2,190
Poids débarqué (tonnes)	1,363	4,317	1,027	51	6,758
Poids moyen par pêche (tonnes)	2.0	4.1	2.5	1.2	3.1
Prise moyenne par pêche pour 1 C.V. développé (Kg.)	21.7	38.8	28.1	15.9	31.6

Il y a lieu d'insister spécialement sur la variation pendant la saison du poids moyen par pêche — maximum en Janvier et minimum en Mars — et de la prise moyenne pour 1 C.V. développé.

Dès la deuxième quinzaine l'on constata déjà un déplacement vers le large en direction de l'est et jusqu'à la fin de la campagne la pêche se concentra principalement à l'est du Wandelaar et à proximité des bouées 1, 2 et 3 de la ligne H. K. (Hoek van Holland).

En dehors des régions précitées quelques bonnes pêches furent faites aux dates et localités suivantes: 23 Janvier, sur la côte Française, entre Dunkerque et Gravelines et le 23 Janvier près des bouées 7, 8 et 9 de la ligne N. F. (South Falls—Flessingue).

2. Flotille et Méthode de Pêche.

A la campagne de harengs guais 1947—48 prirent part 243 chalutiers:

Unités	Type de navires
132	I de 10 à 79 C.V.
42	II de 80 à 119 C.V.
65	III de 120 à 239 C.V.
4	IV dont 3 de 240 C.V. et 1 de 250 C.V

Tous les chalutiers, grands comme petits, ont employé le chalut à panneaux exclusivement. La durée d'un voyage n'excéda point ou rarement les 24 heures.

Le tableau récapitulatif des résultats d'exploitation enregistrés au cours des 7 dernières campagnes de harengs guais (voir Tableau 2) est très significatif quant à l'influence que peut avoir la grande pêche de harengs d'automne sur le rendement de la pêche de harengs guais sur les côtes Belge et Française.

En effet, durant la guerre, lorsque la grande pêche de harengs d'automne fut interrompue, les apports saisonniers de harengs guais s'élevèrent jusqu'à un niveau inconnu jusqu'alors, tandis que la reprise de cette pêche, en 1945, entraîna dans la

suite une diminution formidable et progressive de la pêche de harengs guais.

Il faut donc admettre que la grande pêche de harengs d'automne constitue un prélèvement considérable sur les bancs de harengs guais, qui, chaque hiver, hantent nos régions.

Tableau 2. Récapitulation des résultats enregistrés au cours de la période 1941—42 à 1947—48.

Campagne	Poids débarqué (tonnes)	Capture par pêche (tonnes)	Moyenne par journée pour 1 C. V. développé (kg.)
1941—42	10,007	4.2	119
1942—43	51,895	5.7	164
1943—44	58,119	6.2	130
1944—45	31,446	8.2	159
1945—46	26,359	4.0	68
1946—47	22,172	4.8	50
1947—48	6,758	3.0	32

B. Etude Biologique de la Concentration 1947—48.

Le matériel d'étude comprend 23 séries d'échantillonnage: 19 de 50 et 4 de 25 harengs, soit au total 1,050 individus. En Décembre 1947 l'analyse porta sur 275 individus, en Janvier 1948 sur 400 et en Février sur 375.

Afin de suivre dans le temps tout changement qui pourrait se produire dans la composition de la concentration de harengs, nous répartissons nos observations en périodes mensuelles: Décembre, Janvier et Février.

Toutes les données sont des pourcentages.

1. Taille.

Répartition pour 100 en classe de centimètres.

Mois	Tailles en centimètres										Longueur moyenne en cm.	Poids moyen en g.
	20	21	22	23	24	25	26	27	28	29		
Dec.	0.7	2.2	10.5	7.6	13.1	12.7	15.6	22.2	14.2	1.1	25.40	113
Janv.	—	0.5	4.0	6.5	8.3	14.0	24.3	31.3	9.5	1.5	26.24	118
Févr.	0.3	0.8	4.3	8.0	7.7	14.1	24.0	28.0	11.7	1.1	26.19	113
Total	0.3	1.1	5.8	7.3	9.3	13.8	21.9	27.7	11.5	1.3	26.00	115

Les mensurations ont été faites au millimètre.

2. Poids.

3. Sexe.

4. Graisse mésentérique.

5. Stades de Maturité.

Mois	Sexe		Graisse				Stades de Maturité							
	♂	♀	0	1	+	M	I	II	III	IV	V	VI	VII	VIII-II
Déc.	50.5	49.5	21.4	66.2	9.1	3.3	1.46	1.82	—	0.36	—	0.36	4.00	92.00
Janv.	46.5	53.5	36.5	46.3	16.7	0.5	—	—	—	—	0.25	0.25	0.75	98.75
Févr.	49.6	50.4	40.6	40.0	18.1	1.3	—	0.27	—	—	—	0.53	0.53	98.67
Total	48.7	51.3	34.0	49.3	15.2	1.5	0.38	0.57	—	0.10	0.10	0.38	1.52	96.95

6. Age. Répartition pour 100 des classes annuelles.

Anneaux d'hiver Age (ans)	2	3	4	5	6	7	8	9	+	Nombre d'individus
	3	4	5	6	7	8	9	10	+	
Classes annuelles	1944	1943	1942	1941	1940	1939	1938	1937	antérieur à 1937	
Décembre	19.52	12.43	15.39	4.73	4.73	2.37	14.20	8.29	18.34	169
Janvier	10.85	9.26	16.93	10.58	10.05	3.44	17.73	3.70	17.46	378
Février	4.08	6.12	17.69	8.84	6.12	7.48	23.13	6.80	19.73	147
Total	11.53	9.37	16.71	8.79	7.92	4.03	18.01	5.48	18.16	694

7. Tailles et Age. Taille moyenne observée pour chaque classe d'âge.

Classe	Age	Taille moyenne en cm.				Classe	Age	Taille moyenne en cm.			
		Décembre	Janvier	Février	Pour l'ensemble			Décembre	Janvier	Février	Pour l'ensemble
1944	3	22.88	23.15	23.87	23.09	1940	7	26.92	26.96	27.09	26.98
1943	4	24.97	24.74	24.74	24.32	1939	8	27.13	27.14	27.57	27.31
1942	5	25.55	25.58	25.67	25.59	1938	9	27.53	27.17	27.29	27.27
1941	6	26.48	26.41	26.75	26.49	1937	10	27.65	27.29	27.51	27.48

8. Vertèbres.

Répartition pour 100 du nombre de vertèbres et moyenne vertébrale.

Mois	Nombre de vertèbres						Moyenne vertébrale
	54	55	56	57	58	59	
Décembre	0.36	4.73	47.64	44.36	2.94	—	56.44
Janvier	—	4.75	41.75	47.75	5.75	—	56.54
Février	0.27	4.00	33.85	54.40	7.20	0.27	56.65
Total	0.19	4.48	40.47	49.24	5.52	0.10	56.56

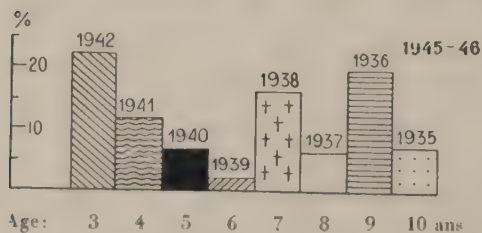
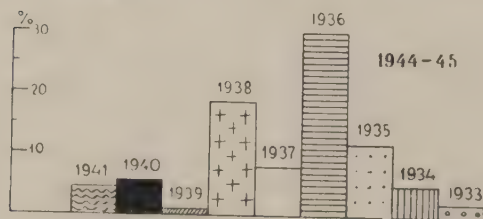
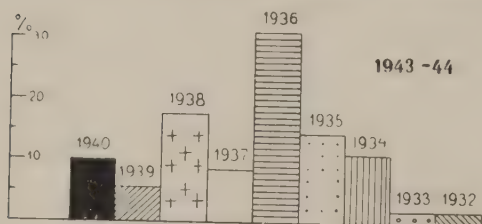
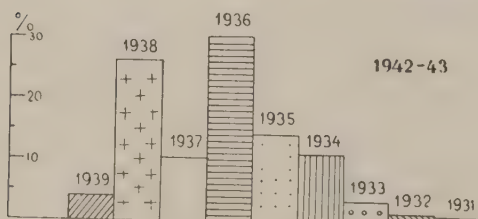
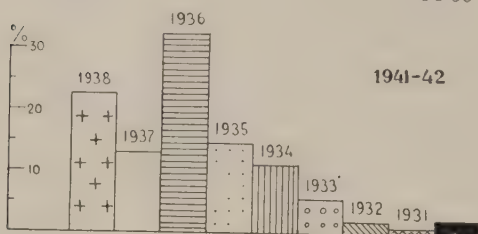
Répartition pour 100 du nombre de vertèbres cervicales et moyenne.

Mois	Nombre de vertèbres cervicales							Moyenne
	22	23	24	25	26	27	28	
Décembre	3.27	27.27	47.64	19.64	2.18	—	—	23.90
Janvier	5.00	30.00	46.50	16.50	1.75	0.25	—	23.85
Février	2.40	24.00	50.40	19.20	3.20	0.53	0.27	23.99
Total	3.62	27.14	48.19	18.29	2.38	0.28	0.10	23.90

9. Ecailles en Carène.

Répartition pour 100 du nombre d'écailles en carène (K2) et moyenne.

Mois	12	13	14	15	16	17	18	Moyenne
Décembre	—	5.45	31.64	48.00	13.09	1.45	0.36	14.70
Janvier	0.25	9.50	39.25	42.00	8.75	0.25	—	11.50
Février	—	8.00	30.13	47.47	13.07	1.33	—	14.69
Total	0.10	7.90	34.00	45.52	11.43	0.95	0.10	14.63



10. Contenu stomacal.

1040, ou 99 % des estomacs étaient vides et 10, ou 1 % contenaient un peu de nourriture: 4 avec 1 *Gobius minutus* et 6 avec des restes fort digérés de copépodes. Le nombre des harengs à estomac vide était pratiquement le même pendant toute la saison, c-à-d. 98.2, 99.2 et 99.5 %, respectivement, dans les mois de Décembre, Janvier et Février

C. Résumé et quelques Considérations.

L'interruption de la grande pêche de harengs d'automne, pendant les 5 années de guerre, entraîna dès l'hiver 1941—42, une abondance inaccoutumée de harengs guais sur la côte Belge, tandis que sa reprise en 1945, détermina à partir de l'hiver 1945—46, une régression considérable et continue de la densité des harengs guais.

Cette abondance alternative confirme d'une façon indéniable, que les harengs guais, qui chaque hiver hantent nos régions, sont des survivants de la grande hécatombe, que constitue la grande pêche de harengs d'automne dans la région méridionale de la Mer du Nord et en Manche Orientale. Dès lors il s'avère que le rendement de la pêche de harengs guais sur les côtes Belges et Françaises ne dépend pas uniquement de la densité des bancs de



Age: 3 4 5 6 7 8 9 10 ans

Fig. 1. Répartition pour 100 des classes d'âges dans les concentrations de harengs guais au cours des hivers 1941—42 à 1947—48.

harengs qui s'acheminent vers les frayères, mais aussi de l'intensité d'exploitation à laquelle ils sont soumis, de la part des "drifters" et des chalutiers, avant et pendant la ponte.

Les concentrations de harengs guais, qui se sont rassemblées sur la côte Belge pendant la saison d'hiver 1947—48, sont caractérisées par l'abondance des harengs de plus de dix ans, parmi lesquels les individus de onze ans (classe 1936) sont de loin les plus nombreux; de neuf ans (classe 1938) et de cinq ans (classe 1942).

Les jeunes harengs de trois ans (classe 1944) apparaissant pour la première fois dans les concentrations de harengs guais, ont été assez abondants et leur contingent dans les concentrations ultérieures peut avoir une influence favorable sur le recrutement.

L'abondance des harengs de plus de dix ans constitue un fait unique dans les annales de nos concentrations de harengs guais, mais elle était prévue, étant donné le haut pourcentage, soit 20 0/0, des harengs de la classe 1936, dans la concentration 1947—48.

Les harengs de quatre ans (classe 1943), de six ans (classe 1941) et de sept ans (classe 1940) étaient une fois de plus pauvrement représentés.

Il est donc probable que la concentration 1948—49 sera caractérisée par l'abondance de harengs des classes de recrutement 1944, 1942, 1938 et par des harengs de douze ans.

Vu le caractère oligospondylique de la concentration 1947—48, au cours du mois de Décembre (moyenne vertébrale 56.44), il faut admettre qu'à ce moment la concentration était alimentée exclusivement par des harengs du type Mer du Nord.

Cependant, à partir de Janvier, l'indice vertébrale devient légèrement polyspondylique (moyenne

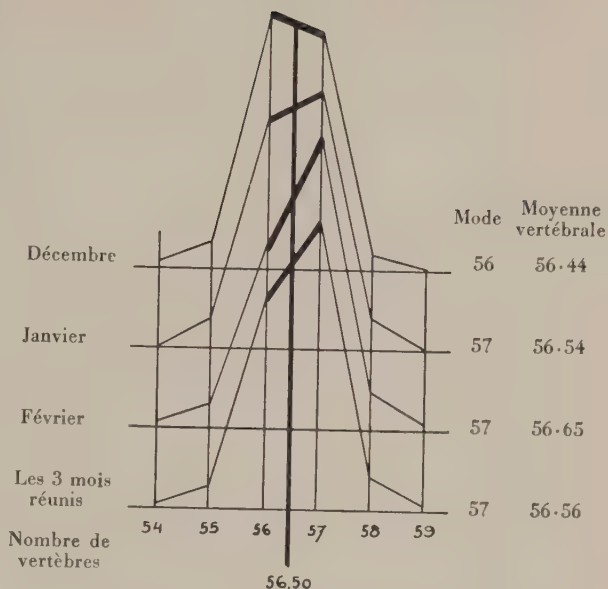


Fig. 2. Polygone de variations du nombre de vertèbres de la concentration de harengs guais 1947—1948.

vertébrale 56.54) ce qui signifie qu'à ce moment déjà les harengs du type Manche commençaient à s'introduire dans le sud de la Mer du Nord.

En Février, le caractère polyspondylique de la concentration fut encore plus accentué (moyenne vertébrale 56.65) et indique une forte pénétration de harengs type Manche dans la Mer du Nord.

The East Anglian Herring Fishery in 1948.

By

W. C. Hodgson and I. D. Richardson.

DURING the East Anglian herring season of 1948, 430 drifters, an increase of 20 on the previous season, operated from Yarmouth and Lowestoft. Many more motor vessels took part in this fishery.

Few landings were made before 11th October when the fishery started on the recognised grounds. Prior to this date the fishery was well to the north. In the following table the 1948 season is compared with that of 1947.

Port	No. of landings		Average crans per landing		Total landings	
	1948	1947	1948	1947	1948	1947
Lowestoft	3,748	3,093	48.0	53.3	179,822	164,867
Yarmouth	6,211	5,202	47.7	46.4	296,194	241,449

The percentage age-composition of the herrings landed during the period October 9th to December

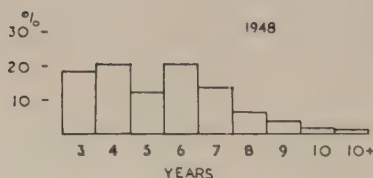


Fig. 1.

4th is shown in Figure 1. Four strong age-groups are indicated: the 3, 4, 6, and 7-year-old groups.

The strong 3 and 4-year-old groups promise well for the 1949 season whilst the fairly strong 6 and 7-year groups which will still be represented in the catches of the 1949 season as 7 and 8-year-old fish, should support a good November fishery.

Usually the younger fish appear in the catches early in the season and the older fish appear later. In Figure 2 the number of herrings in an average catch during each week of the season is plotted in the form of histograms. Until the week ending 30th October, the 3 and 4-year-old fish are seen to be well represented, but after this date the older fish of 6 and 7 years old, make up the major part of the landings.

The moon affects the size in the East Anglian catches to a marked extent and it has usually been found that, should the full moon fall, as it did during the 1948 season, on the 18th October and 16th November, there are two peak periods in the fishery. As the moon appears to affect the catches to a greater extent when the young fish are on the grounds than when the older fish make up the bulk of the catches, there should be an increase in the average landing per vessel during the period of the October full moon, and these average catches should be greater than those at the period of the November full moon. In Figure 3, the average catch per boat for each week of the season is plotted. The graph indicates that there were greater catches at the November full moon than in the week during which the October moon fell. At the time of the Novem-

INTERVALS—10,000 FISH

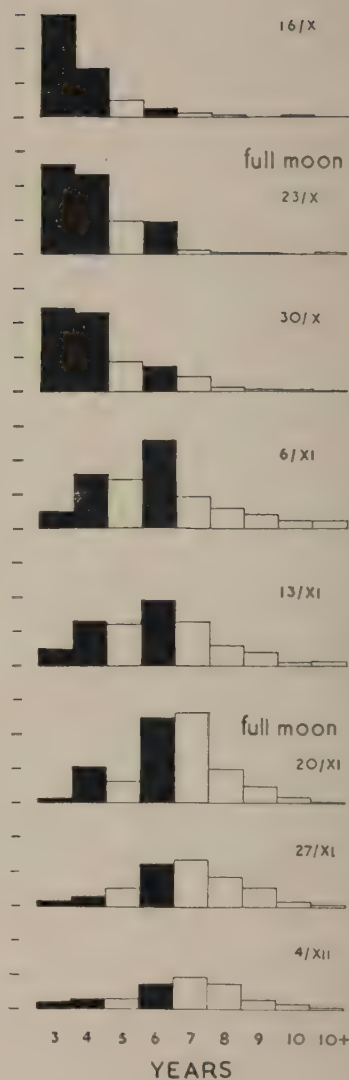


Fig. 2.

ber moon the catches were made up of the older fish which were represented in large numbers.

A greater percentage of the typical East Anglian "October" herrings was found during the early part of the season, than in the previous seasons. These fish have not been represented in the catches to any great extent since the war but prior to the war they supported the main fishery in October.

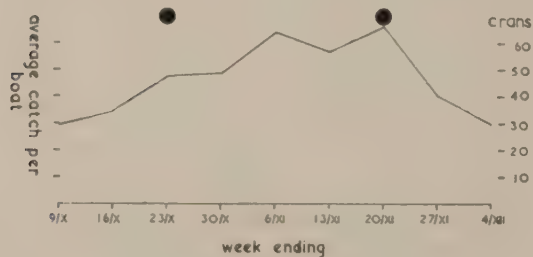


Fig. 3.

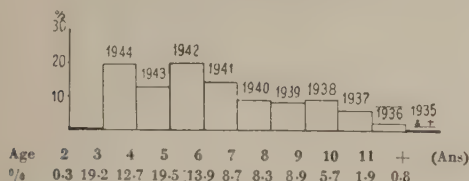
Hareng du Sud de la Mer du Nord et de la Manche Orientale.

Par

J. Ancellin.

1. Lieux de pêche.

La pêche du hareng "plein" se pratiqua dès le début de Novembre 1947 à bord de drifters de faible tonnage sur les lieux de pêche habituels, au large de la littoral boulonnais (Bassure de Baas, Ver-



Composition du stock de Harengs du Sud de la Mer du Nord et de la Manche orientale.
(1947—1948)

goyer.) Elle se termina vers la mi-Décembre. Dans le courant de Janvier les chalutiers commencèrent à exploiter les bancs des Flandres où se trouvait le hareng "guai"; les lieux de pêche fréquentés se situaient à 5/10 milles au large de la côte Belge, d'Ostende à Zeebrugge. Les dernières captures de hareng "guai" s'effectuèrent vers le 28 Février 1948,

dans les parages de l'île de Walcheren (chenal Roompot).

2. Composition du stock.

Il y a lieu de noter l'importance relative de la classe 1944 (harengs de 3 ans). Les autres classes, à l'exception des plus anciennes (1937, 1938, 1939) qui restent au dessus de la moyenne, sont moins bien représentées.

3. Moyenne vertébrale.

Le groupe "Nord—Somme" (harengs de la Manche Orientale) présente une moyenne vertébrale de 56.58.

Le groupe "Dyck—Sandettié" (harengs du Sud de la Mer du Nord) présente une moyenne vertébrale de 56.67. En ce qui concerne ce dernier groupe les variations suivantes ont été observées au cours des deux premiers mois de l'année: Janvier, 56.62; Février, 56.73.

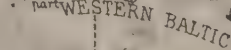
On constate par rapport aux résultats des années précédentes la persistance de l'élévation relative de la moyenne vertébrale pour la population "Dyck—Sandettié" (de 1928 à 1937 la moyenne vertébrale de ce groupe n'a jamais dépassé 56.65.)

1. Taille. Pourcentage.											N	Taille moyenne rectifiée par 0.50
cm.	20	21	22	23	24	25	26	27	28	29		
Mer du Nord, Groupe Dyck—Sandettié	0.6	4.3	8.9	11.5	10.2	20.8	25.1	15.5	2.6	—	302	25.33
Manche Orientale, Groupe Nord—Somme	—	1.0	5.6	9.5	13.8	19.1	26.5	19.8	3.5	0.7	282	25.75

NB. La taille est calculée au centimètre près et ramenée au centimètre inférieur.

2. Age. Pourcentage.											N	
Anneaux d'hiver	1	2	3	4	5	6	7	8	9	10		
Age	2	3	4	5	6	7	8	9	10	11		
Classe	1945	1944	1943	1942	1941	1940	1939	1938	1937	1936	Ant.	
Mer du Nord, Groupe Dyck—Sandettié	0.6	18.9	12.8	20.3	11.5	8.8	8.8	9.4	5.7	2.7	—	295
Manche Orientale, Groupe Nord—Somme	—	19.4	12.6	18.7	16.6	8.6	7.9	8.3	5.7	1.0	0.7	277

3. Moyenne vertébrale. Pourcentage.										
Nombre de vertèbres	55	56	57	58		Mer du Nord	Manche Orient.		Mer du Nord	Manche Orient.
Mer du Nord, Groupe Dyck—Sandettié	2.0	36.1	54.1	7.6	N	288	256	$\sigma =$	± 0.643	± 0.645
Manche Orientale, Groupe Nord—Somme	2.7	42.1	49.2	5.8	Mode	57	57	Fl. =	± 0.127	± 0.135
					Moyenne	56.67	56.58	Fl. M. =	56.55	56.45
									à 56.79	à 56.71



Map of the Danish Waters showing Limits between the Different Areas.

Transition Area.

INTRODUCTION.

CONTRIBUTIONS have been received from Denmark (H. Blegvad, Aage J. C. Jensen, J. B. Kirkegaard, J. Knudsen, H. Thomsen, and Erik M. Poulsen), Norway (Alf Dannevig) and Sweden (Arvid R. Molander).

A. Environment.

Hydrography. Along the south coast of Norway the surface temperature was rather low in winter but somewhat above normal later in the year. In the Danish waters the surface temperatures were on the whole normal; the bottom temperatures were however a little below normal in the late summer. The salinity of the bottom water was very low in the Danish Belts in late spring.

Benthic Food. The amount of 1st-class food for the bottom fish in the Limfjord was considerably below normal, whereas some of the larger bottom animals (*Mytilus edulis* and *Ascidia aspersa*) showed an increase in abundance.

B. Fish.

Fish Eggs and Larvae. At the Flødevigen hatchery it was observed that fish eggs were often infested with a flagellate, although the eggs hatched provided the infestation was not too heavy. The rearing of cod and plaice larvae in aquaria was carried out with success; but at the age of 4 weeks a heavy mortality occurred among the cod larvae, owing to a disturbance in the air-bladder.

Gadoids. Along the south coast of Norway the number of young (0-gr.) cod and pollack was low, but the number of young whiting was just above normal.

In the Limfjord no 0-group cod were caught. In the Belt Sea the number of 1-group cod was rather high.

Plaice. In the Skagerak and the northern Kattegat the abundance of the 0-group fish was considerably above normal; approximately normal in the central Kattegat, but far below normal in the southern parts of the Danish Seas. Along the Swedish coast of the Skagerak and the central Kattegat the 0-group was below normal in July, but somewhat richer, though still below normal in the southern Kattegat. Aage J. C. Jensen draws attention to the fact that the survival of the young of the plaice is better with higher than with lower temperatures and salinities, this being in good accordance with

the statements made by A. C. Johansen in 1927 (Rep. Danish biol. Stat. XXXIII).

The stock of plaice (all age-groups) was below normal in the Limfjord, especially in the autumn. The Isefjord contained only a small stock of plaice.

Market measurements of plaice showed that in the northern Kattegat the mean length had decreased somewhat, but had increased in the southern Kattegat owing to the low level of the stock. In the inner Danish waters the stock which had accumulated during the war years has disappeared.

100,000 Kg. of young plaice were transplanted from the nursery grounds in the western part to the central part of the Limfjord and 62,000 Kg. to the Belt Sea and adjacent waters.

Turbot. The 0-group was very poor in the Kattegat and the Belts.

Flounder. The 0-group stock was a little above normal in some areas but somewhat below normal in others.

Herring. Samples of herrings from various parts of the Danish Seas were analysed for size, age and race. The Bank herring made up a considerable proportion of the samples of young herrings from the northern coast of Jutland, with Atlanto-Scandian spring herring and fish from the Kattegat often being present in addition. Young herring from the Kattegat penetrate extensively into the Belt Sea. It may be noted that the analyses showed no new rich year-class to have appeared among the autumn spawning Belt herring.

Eel. The stock of eel in the Limfjord has improved a little, being very near the normal for the years 1927—39. In the Isefjord a decrease in the stock has taken place since 1947.

Fish for Processing. The increase in the catch of fish for fishmeal and trout-ponds is heavy: in 1946 it was 11 million Kg., in 1948 42 million Kg. By far the largest part is caught in the Skagerak and the northern Kattegat. The majority of the catch consists of whiting and herring. The analyses of the catches were continued. These investigations are being continued and extended in the present year.

Marketable Crustaceans. The investigations on the edible crustaceans have been continued.

Oyster. The collecting of spat in the ponds at Flødevigen gave poor results. In the Limfjord a considerable indigenous stock of both young and old oysters was found. An experimental transplantation of spat to the Danish Wadden Sea was carried out.

Erik M. Poulsen.

ENVIRONMENT.

Hydrography.

1. Norway Coast of Skagerak.

The sea temperature at Flødevigen near Arendal was relatively low during January and February. Later it was higher than normal.

Table 1. Surface Temperature at Flødevigen.

Average:	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919—45	3.04	1.96	2.24	4.53	9.00	12.91	16.19	16.52	14.45	11.22	7.69	5.09
1946	3.4	2.8	1.4	5.0	10.8	12.9	16.8	16.6	15.3	11.3	7.8	5.2
1947	1.3	—0.2	—0.1	3.7	11.3	14.2	17.0	19.7	16.7	12.9	8.3	5.9
1948	2.6	1.6	2.8	6.3	10.5	13.4	16.6	17.3	14.7	11.3	7.9	6.7

Alf Dannevig.

2. Kattegat and Belts.

Table 2. Monthly Means of Salinity at Surface and Bottom at the Lightvessels "Anholt Knob" (A), and "Halsskov Rev" (H), for a series of years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Dept.)

Lightvessel	Surface.											
	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX
A Mean	20.7	21.9	22.8	23.5	23.1	20.2	19.2	18.1	18.9	19.4	20.1	20.7
H "	16.2	16.3	15.6	16.8	14.8	13.4	13.9	13.0	14.3	13.9	14.4	14.6
A 1947	4.2	0.2	—0.4	1948	—1.1	—4.3	0.5	0.3	—0.8	—0.7	—1.2	—0.9
H 1947	0.4 ¹⁾	0.7	1.2	1948	0.4	0.3	2.7	—1.8	—0.5	—0.2	0.3	0.2
Bottom.												
A Mean	32.2	32.4	32.1	31.8	32.0	32.5	33.0	33.1	32.8	32.3	31.9	31.8
H "	23.3	21.5	22.1	21.9	21.7	24.5	27.6	29.4	30.3	29.4	27.6	24.7
A 1947	—0.4	0.7	1.7	1948	1.5	1.4	0.7	—0.3	0.2	0.7	1.1	1.3
H 1947	—2.5 ¹⁾	1.3	—3.2	1948	—1.4	2.4	1.2	—3.2	—5.0	0.6	1.3	2.1

Table 3. Monthly Means of Temperature at Surface and Bottom at the Lightvessels "Anholt Knob" (A) and "Halsskov Rev" (H), and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Dept.)

Lightvessel	Surface.											
	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX
A Mean	10.9	7.1	4.1	2.2	1.4	1.9	4.5	9.4	14.2	16.8	16.7	14.5
H "	11.1	7.3	4.0	2.4	2.0	2.4	4.5	8.9	12.7	15.7	16.4	14.5
A 1947	0.5	0.2	0.6	1948	0.2	—0.4	0.7	2.5	1.6	1.0	1.8	1.1
H 1947	0.4 ¹⁾	0.7	1.2	1948	0.4	0.3	0.4	2.0	2.0	2.4	1.2	0.4
Bottom.												
A Mean	12.1	10.2	8.1	6.1	4.7	4.3	4.3	4.9	6.7	9.7	12.7	13.1
H "	11.6	8.4	5.9	3.9	3.4	3.4	4.3	5.7	7.1	9.1	11.7	13.2
A 1947	0.6	0.0	0.8	1948	1.4	0.8	0.7	0.6	0.7	0.9	—0.6	—0.8
H 1947	0.4 ¹⁾	1.2	0.0	1948	—0.2	0.9	0.9	1.6	1.8	0.2	—0.2	—0.1

¹⁾ Mean of 21 days, observations 1.—10. failing.

Table 4. Monthly Means of Residual Surface Currents in cm./sec. at the Lightvessel "Halsskov Rev". The Current from the Baltic is stated as positive, towards the Baltic as negative.

(From the Danish Meteorological Institute, Nautical Department).

	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX
1947	22.0	—25.8	5.7	1948	19.2	14.0	—16.2	12.3	8.4	—4.1	14.1	—3.1	—10.4

Helge Thomsen.

Benthic Food.

As in previous years valuations with the Petersen grab (0.1 m².) were carried out in the central and western part of the Limfjord in the spring (June) and in the autumn (September). The table gives the results for the two largest broads, Livø Br. and

Nissum Br. In each of these, 20 stations were worked during each investigation.

It appears that in both broads the amount of 1st- and 2nd-class fish food was considerably below the mean value for the period 1926—46, as it has been now for several years. During the severe winters 1940—42 and 1947 a definite decrease in the amount of fish food took place. The winter of 1948 was not particularly severe but, nevertheless, no recovery has taken place as it did during the period 1943—46. In both broads the group "non food" (consisting mainly of *Mytilus* and *Ascidella*) was considerably above normal as has been the case now for several years. In Nissum broad there has apparently been a great decrease during the winter, while in Livø broad a slight increase in abundance was observed.

Jørgen Knudsen.

Table 5. Weight in g./m.² of Bottom Invertebrates in the Limfjord.

For explanation of the terms 1st-class Food etc. vide Ann. Biol. III p. 86. A. = autumn, S. = spring.

	Livø Br.			Nissum Br.		
	1st Class	2nd Class	Non-Class Food	1st Class	2nd Class	Non-Class Food
A. 1947	22.6	38.5	386	5.6	41.4	485
S. 1948	2.2	5.4	910	2.1	1.7	6
Mean	12.4	21.9	898	3.9	21.6	246
Mean 1926—46	19.9	22.2	260	9.4	11.9	79.3

THE FISH.

Fish Eggs and Larvae.

Parasites in Fish Eggs. When examining the preserved pelagic fish eggs caught in nature I often have observed fine spots on the egg shell. The same phenomenon was later observed by my assistant, cand. real. C. F. Kolderup. During the 1948 hatching season Kolderup studied the cod eggs in the hatchery, and as he also found the same spots in the live material he was able to ascertain that the spots were due to some parasites living immediately inside the egg shell. A sample was sent to cand. real. O. laug Sømme. It appeared to be a flagellate, the size of which varied between 18 and 32 μ . They sometimes occurred in hundreds in a single egg, giving the living egg a somewhat milky appearance. Provided the attack was not particularly strong the eggs hatched in a normal way.

Rearing. The rearing of plaice larvae was a success practically no mortality occurring. The results with cod larvae were also very promising, but

at an age of about 4 weeks after hatching a heavy mortality occurred, the air bladder becoming enlarged and often punctuated.

Alf Dannevig.

Gadidae.

1. Norwegian Coast.

The normal experimental fishing in the littoral region in September and October gave the average numbers per haul recorded in Table 6. In both areas the number of 0-group cod and pollack was low, but the number of whiting was just above normal.

Experimental fishing with traps at Flødevigen resulted in 94 cod per trap. The 1947 year-class was relatively very abundant. Vertebrae counts of 139 specimens (16. December 1948) gave the very high number of 52.50.

Table 6. Mean Number per Haul of young Cod, Whiting and Pollack.

	Cod		Whiting	Pollack
	0-Gr.	I-Gr. ¹⁾	0-Gr.	0-Gr.
Skagerak Coast				
76 hauls				
Average 25 years	13.7	1.7	17.8	16.6
1945	13.0	1.0	65.9	32.8
1946	1.8	1.1	20.9	3.6
1947	2.5	0.4	22.6	2.2
1948	4.3	1.7	19.0	1.4
Oslofjord				
59 hauls				
Average 6 years				
1936/39, 1945/46	37.9	3.5	13.3	5.4
1945	92.0	1.2	34.5	16.0
1946	0.9	9.1	15.3	0.6
1947	2.4	0.5	16.1	0.9
1948	7.1	0.4	17.1	1.5

¹⁾ A few older included.*Alf Dannevig.***2. Danish Waters.**

In the Limfjord very few **cod** were caught by experimental fishing as in the preceding years, the 0-group being entirely absent. In the Isefjord complex, where a quantity of 0-group fish were caught in 1947, a considerable amount of I-group fish of 20—30 cm. length were found in 1948. The few fishing experiments in the Belt Sea also yielded a number of I-group cod.

*Aage J. C. Jensen.***Flat Fish.****1. Coastal Investigations. 0- and I-Groups.**

a) **Danish Coasts.** The number of 0- and I-group **plaice** and of 0-group **flounder** caught in 1948 are given in Table 7. No 0-group **turbot** were found. The means for a series of years are given in Ann. Biol. IV. From the survey given in Ann. Biol. III, p. 93, of the meteorological-hydrographical factors influencing the strength of year-classes, it is seen that the surface temperature of January—February is of special importance for the 0-group in the Belt Sea, while the March—April temperature is of significance for the Kattegat fish. The temperature was a little above normal in Jan.—Febr. 1948, but in March—April the temperature was very high, (see Table 2) which agrees well with the presence of a rich 0-group in the Kattegat. Furthermore, the surface salinity is positively correlated with the strength of the year-classes and the very low salinity in 1948 may explain the poverty of the 0-group in the Belt Sea.

*Aage J. C. Jensen.***Table 7. Number of Plaice and Flounder caught at 1—2 m. depth.**

(See Figs. 1 and 2). In brackets; mean for 1927—48.

	No of Stations	Plaice		Flounder
		0-Group	I-Group	0-Group
Skagerak	15	36(23)	9(8)	0(0)
N. Kattegat	15	121(35)	15(24)	0(0.3)
C. Kattegat	25	14(14)	0(4)	13(1)
S. Kattegat	11	6(13)	0(0.9)	0(0.2)
Sound	18	1.2(10)	0.4(1.0)	9(10)
Belts	82	5(17)	0.4(1.1)	0.2(4)
W. Baltic	6	0.9(6)	0.6(1.0)	0(2)

b) **Swedish Coasts.** The investigations which were carried out in July show that the average abundance of the 0-group **plaice** along the Swedish coasts of the Skagerak and the central Kattegat was less than the mean for 1929—38 and considerably lower than for 1947. On the other hand the 0-group was very much richer than in 1947 in the southern Kattegat and the Sound although below the mean for 1929—38 in the former area. The great abundance of 0-group plaice in 1947 in the Skagerak and the central Kattegat is reflected in the good catches of I-group fish in these areas in 1948 (see Figs. 1 and 2).

Table 8. Number of Plaice and Turbot caught at 1/2—2 m. depth.

(See Figs. 1 and 2).

Plaice.							
	No. of Stations	1948		Mean 1929-38		1947	
		0-Gr.	I-Gr.	0-Gr.	I-Gr.	0-Gr.	I-Gr.
Skagerak	35	56	7	50	0.8	171	0.8
C. Kattegat	8	32	10.1	75	2	77	2
S. Kattegat	29	52	2.1	96	2	10	2
Sound	4	13	0	7	0	3	0
Turbot.							
	No. of Stations	1948		Mean 1929-38		1947	
		0-Gr.	I-Gr.	0-Gr.	I-Gr.	0-Gr.	I-Gr.
Skagerak	35	0	0.2	0.6	0.1	0.8	0
C. Kattegat	8	0	0.2	1.9	0.1	7.8	0
S. Kattegat	29	0	0.1	4.4	0.4	4.5	0
Sound	4	0	0	0	0.5	6	2.7

0-group **turbot** which in 1947 were fairly abundant on some coasts, failed totally in 1948 on both the Swedish and Danish coasts. The I-group was also scarce.

Arvid R. Molander.

2. The Limfjord.

Investigations were carried out by means of the eel-tog during summer (June) and autumn (September):

The numbers of **plaice** caught per 30 min. in the various parts of the Limfjord are shown below. The numbers in brackets give the average for the period 1927—39.

	Nissum broad	Venø-Kås	Sallings.
Summer	320(356)	22(84)	23(46)
Autumn	231(481)	2(92)	0.3(12)

	Livø Br.	Thisted-Visby Br.	E. of Salling
Summer	1(6)	5(12)	0.7(5)
Autumn	0.3(2)	0.3(4)	0(1)

The stock of plaice was thus considerably below normal in both summer and autumn. The catches in autumn were particularly low, being the lowest since 1941 in Nissum broad, and the lowest observed since 1927 in Livø broad.

The age-composition of the stock in Nissum broad was as follows:

Age-Gr.	Year-Class	June	September
0	1948	0(0)	30(40)
I	1947	16(76)	65(224)
II	1946	130(154)	83(149)
III	1945	136(103)	42(62)
IV+	1944	38(27)	12(17)

The numbers in brackets give the means for 1927—39. In June the numbers of I- and II-group fish were far below normal, but those of III- and IV+ group fish were above normal. In September all the age-groups were considerably below normal. The number of the 0-group fish, however, was higher than in any year since 1940.

The abundance of **dab** in the Limfjord was somewhat below the normal in 1948. Thus, for the whole fjord 9 per 30 min. were caught in June as against the mean for 1927—39 of 11, and 7 in September as against 21. In Nissum broad the mean for June and September was 44 compared with the normal figure of 89. About 92% of the dab caught in September belonged to the I-Gr. In the inner parts of the fjord only very few dabs were caught.

Neither the plaice nor the dab spawn in the fjord, but migrate to it from the North Sea. The fact that dab as well as plaice of all age-groups were far below their normal abundance makes it evident that the scarcity of these fishes in the autumn of 1948 was not caused by poor year-classes but largely by a very weak immigration during spring and summer.

The stock of **flounder** was somewhat below the mean for the years 1927—39 (1.0 per 30 min.

against a mean of 1.2). In the various areas the following numbers were caught per 30 min.

	Nissum Br.	Venø-Kås	Sallings.
June	0(0.5)	2.0(1.3)	3.0(1.1)
Sept.	0.5(0)	0(0.4)	0(0.4)
Mean	0.3(0.3)	1.0(0.8)	1.5(0.7)

	Livø Br.	Thisted	E. of Salling.
June	2.7(3.0)	2.3(1.9)	0.3(2.6)
Sept.	0.9(2.6)	0.3(0.7)	0.3(0.4)
Mean	1.8(2.8)	1.3(1.3)	0.3(1.5)

The figures in brackets denote means for 1927—39. In the western parts, therefore, the stock was a little above normal, but below in the central part.

Erik M. Poulsen.

3. Isefjord, Southern Kattegat and Belts.

In the Isefjord quantitative fishing experiments showed that there were only very few **plaice**, as was also the case in 1947.

I-group **flounder** were more abundant than usual, promising a good catch in 1949 when they will have reached the size-limit. As usual the **dab** was very scarce in this fjord.

In the southernmost Kattegat only two hauls with the eel-tog were carried out. No **plaice** or **flounder** were found here but 215 **dab** were caught per 30 min. haul. This is about the same density as before the war.

Some quantitative fishing experiments were also carried out in the Aarhusbay and between Fyn and Langeland after a break in these investigations since the beginning of the war. The stock of **plaice** was of similar density to that before the war and consisted mostly of II-group fish from the good 1946 year-class. Very few **flounder** were caught. In these waters the density of the **dab** stock seems to have been somewhat less than before the war.

Aage J. C. Jensen.

Plaice.

1. Size and Age-Composition of Commercial Catches.

Market measurements of representative samples have been continued at the fishing ports of Skagen, Frederikshavn, Vesterø (Læsø), Grenaa and Bagenkop.

The length distributions of some of the catches have been shown in Table 9.

In the comparatively deep water to the north of the Scaw (45—50 m.) the mean length in January 1948 was 2 cm. less than in January 1947. The age-analysis (see Table 10) shows that this is caused by the predominance of the 1945 year-class in 1948



Fig. 1. Number of Plaice of the 0-Group (year-class 1948) taken per fishing unit in the summer of 1948. The fishing unit used was a 30-minute haul with Johansen's young-plaice trawl, at Bornholm partially a 30-minute haul with hand push-net (the figures inside the coastline).

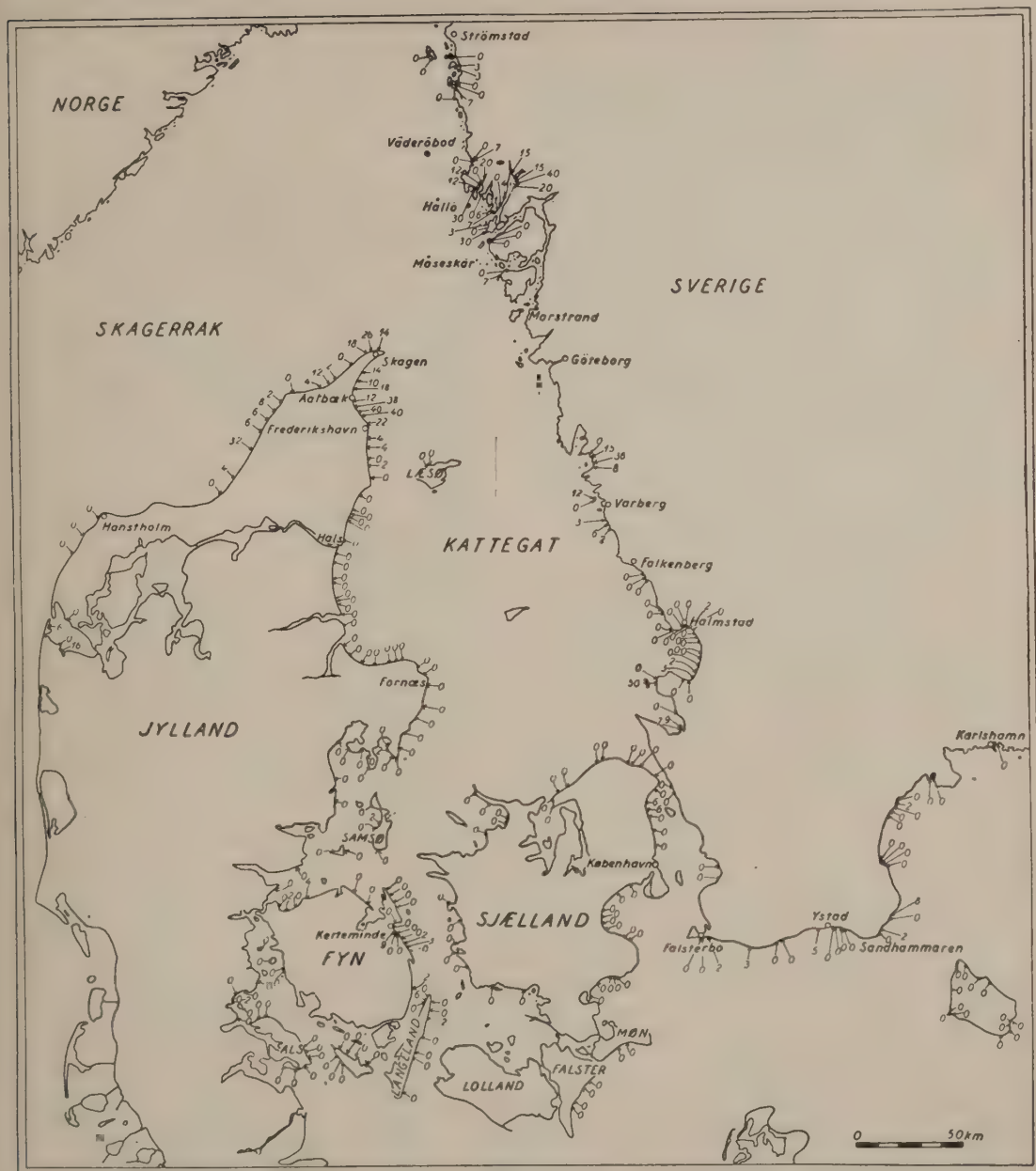


Fig.2. Number of Plaice of the I-Group (year-class 1947) taken per fishing unit (see Fig.1) in the summer of 1948.

(age-group II). This year-class must have been a rich one in these waters although there were no coastal investigations in 1945 and 1946 which would have allowed an assessment of its strength.

To a less extent a similar fall in the mean length of the commercial plaice is found as far south as at Anholt (see Table 9).

Along the eastern coast of the northern Kattegat the mean length of plaice was about 30 cm. at depths between 5 and 15 m. This is the normal figure, and is due to the plaice emigrating from these grounds, and being caught, when they reach lengths of about 30 cm. and upwards.

Off Hals (the entrance to the Limfjord) at 9 m. depth and in the western part of the central and southern Kattegat the mean lengths of commercial plaice was $\frac{1}{2}$ –5½ cm. greater in 1948 than in 1947. This increase corresponds to the fact that in these areas the commercial stock has got only a small recruitment of 2-year-old plaice and the 1946 year-class here was very much poorer than the 1945 year-class. Hence the average age of the commercial stock must have been about a year higher in 1948 than in 1947.

Table 9. Length-Distribution (%) of Commercial Plaice.

	Depth m.	26- 30	31- 35	36- 40	Length, cm. 41-45 46-50 51-60			Mean
N. of the Skaw.								
1947, Jan.	45	19	38	29	12	2	—	35.3
1948, Jan.	47	23	58	17	—	—	2	33.3
N. of Anholt								
1947, Jan.	23	20	39	39	2	—	—	34.6
1948, Febr.	26	12	72	12	4	—	—	33.9
Off Hals								
1947, Aug.	9	50	49	11	—	—	—	30.6
1948, July	9	32	46	19	3	—	—	33.8
Near Østre Flak (Aalborg bay)								
1947, June	12	99	1	—	—	—	—	27.5
1948, May	7	30	47	20	3	—	—	33.0
Off Fornæs								
1947, June	18	55	12	33	—	—	—	32.5
1948, July	15	19	53	28	—	—	—	34.3
At Havknude Flak (S. of Grenaa)								
1947, Aug.	20	33	43	17	7	—	—	32.7
1948, July	14	34	49	16	1	—	—	33.2
WSW. of Bagenkop (S. Langeland)								
1946, Dec.	28	32	57	11	—	—	—	31.7
1948, Jan.	30	24	24	28	19	—	5	36.4
S. of Bagenkop								
1946, Dec.	23	55	32	10	3	—	—	31.6
1948, Jan.	23	23	27	41	5	4	—	34.7

Table 10. Age-Composition (%) of Commercial Plaice caught N. of the Skaw.

(see Table 9).

	II	III	IV	V
1947, Jan.	36	52	5	7
1948, Jan.	84	4	6	6

There was also a large increase in mean length in January 1948 in the southern part of the Belt Sea (Bagenkop). In the Belt Sea the 1946 year-class was very much stronger than that of 1945, but in January 1948 these plaice had not joined the commercial stock. In the later part of the year, however, they formed the main part of this stock.

In the inner Danish waters there is practically nothing remaining of the accumulated stock of large plaice resulting from the closure to fishing of some areas during the war. The catch now, therefore, fluctuates from year to year according to the strength of the year-classes of about 2 years earlier.

Age J. C. Jensen.

2. Transplantations.

Transplantations of young plaice were carried out in April, as in previous years, to the Belt Sea and adjacent waters and to the inner broads of the Limfjord.

The plaice for transplantation were caught mostly in the Nissum broad, although a few, some 5%, were taken in the North Sea off Thyborøn. The mean length of the transported plaice was 20.4 cm. and the mean weight 90 g.

Age- and length-analyses of samples of the fish gave the following results:—

Plaice from the Nissum broad

Age-group	II	III	IV	V	VI	Total
Year-class	1946	1945	1944	1943	1942	
No. investigated	45	651	704	258	13	1661
%	3	39	42	16	1	
Mean length cm.	14.0	17.7	20.5	23.0	24.7	19.9

Plaice from the coastal waters of the North Sea off Thyborøn

Age-group	II	III	IV	V	VI	Total
Year-class	1946	1945	1944	1943	1942	
No. investigated	6	57	166	154	9	392
%	2	15	42	39	1	
Mean length cm.	17.5	20.9	23.3	24.0	25.1	23.2

Fish from the coastal waters of the North Sea were therefore somewhat older, and had a greater length at a given age, than those from Nissum broad. The number of anal fin rays were also counted.

**Table 11. Racial Characters of Herring used for processing,
caught at the Skaw.** (In brackets: No. of specimens).

Date and Year	No. of rings	Length, cm. ¹⁾	V. S.	V. P.	K ₂
20.11.47	—	9—13	56.49(91)	24.27	14.75(55)
	—	13—16	56.76(21)	24.48	14.38(48)
9.12.47	0	10—13	56.17(41)	24.14	—
	0	13—17	56.65(57)	24.32	—
	1	12—17	56.25(16)	23.81	14.86(21)
9.3.48	0	13—18	56.60(87)	24.21	14.86(42)
	1	13—18	56.36(34)	23.97	14.67(33)
6.4.48	0	12—18	56.57(58)	24.12	14.91(96)
9.4.48	1	13—17	56.11(32)	23.55	14.46(39)

¹⁾ The lengths are upper and lower limits, e.g., 9—13 cm. are between 9.0 and 12.9 cm.

a) Transplantations to the Belt Sea and adjacent waters. The following table gives the weight and number of plaice transplanted to the various areas:—

	Kg.	Nos.
Southern Kattegat	8,140	82,200
The Sound	8,520	88,000
Northern Belt Sea	20,300	219,900
Southern Belt Sea	24,950	256,000
Total	61,910	646,100

These quantities are about the same as in 1947. Samples of the transplanted plaice were marked, but only a few (between 3 and 15 from the various samples) were recaptured during the 1st year following liberation.

b) Transplantations to the inner parts of the Limfjord. Of the plaice caught for transplantation 100,000 Kg. or 1,153,100 individuals were transplanted to the broads of the central part of the Limfjord.

Samples of the transplanted plaice were marked, from which between 12 and 53 % were recaptured during the first year following liberation.

Erik M. Poulsen.

Herring.

1. Skagerak and northernmost Kattegat.

During the winter and spring season of 1947/48 four samples of small herring caught for processing and six samples of large herring caught for consumption, were examined (see Tables 11 and 12).

**Table 12. Maturity, Length and Racial Characters of Herring caught
in the Skagerak for Consumption.**

Date	Length, cm.		Maturity							
	from	to	mean	I	II	III	IV	V	VI	VII
3.12.47	17—27		20.8	72	16	8	1	—	—	3
16.12.47	20—31		26.7	2	12	2	1	1	—	39
4.2.48	16—30		23.1	36	26	2	—	1	—	22
17.2.48	19—30		25.5	2	26	11	1	—	—	61
4.3.48	21—29		24.9	—	24	16	3	11	—	8
31.3.48	23—32		28.0	—	11	4	2	—	—	14
										69

Racial Characters. (In brackets: No. of specimens).

Maturity Date	V. S.	I, II, III V. P.	K ₂	V. S.	VII, VIII V. P.	K ₂
3.12.47	56.31(115)	24.00	14.57(115)	—	—	—
16.12.47	56.5 (19)	23.8	15.2 (19)	56.19(99)	23.91	14.74(99)
4.2.48	56.65(77)	23.87	14.73(77)	56.52(42)	23.95	14.90(42)
17.2.48	56.39(46)	23.93	14.59(72)	56.32(73)	23.74	14.75(72)
4.3.48	56.3 (15)	23.9	14.5 (15)	56.3 (18)	23.7	15.2 (18)
31.3.48 ¹⁾	56.4 (17)	23.8	14.8 (17)	56.36(78)	23.76	14.85(83)

¹⁾ 2 of mat. IV included under mat. II-III.

Table 13. Racial Characters of Small Herring from the Kattegat and the Belt Sea

In brackets: no. of specimens.

	Date	Length, cm.	V. S.	V. P.	K ₂
At Hurup	4.8.48	6—12	56-18(165)	—	14.55(193)
Off Flensborg Fj.	22.11.47	9—18	55-73(196)	23-55	13-73(152)
Aabenraa Fjord	23.3.48	10—21	55-69(274)	23-44	14-06(176)
At Bogense	6.12.47	10—16	56-30(149)	24-05	14-21(93)

From the racial analysis it is seen that most of the samples of small herring were mixtures of different races. They have been divided into fairly pure races by sorting them according to length and scales. Most of those without rings are autumn spawners from the western North Sea, but the high V. P. in the samples taken on the 20.11.47 (less than 13 cm.), 9.12.47 and 9.3.48 suggest a mixture with spring spawners of Atlanto-Scandian type, while the larger specimens of the 20.11.47 sample (where the scales have not been examined) have nearly all been members of this race-group.

The 1-ringed herring are autumn spawners from the western North Sea mixed, particularly in the April sample, with spring spawners from the Kattegat.

These herring cannot be Kobbergrund herring (which might be suggested by their V. S.) on account of the fact that this race is characterized by a much higher V. P. (c. 24-35).

In the samples of large herring those of maturities VII and VIII were practically all autumn spawners from the western North Sea, while those of maturities I, II and III, which were mostly young herring with 1—3 rings, were of mixed origin.

They were probably, for the most part, summer and autumn spawners from the western North Sea, but the widely varying K₂ indicates that they belong to rather different parts of this race-group, and in the samples from 3.12.47 and 4.3.48 they may be mixed with spring herring from the Kattegat.

2. Kattegat and Belt Sea.

During the summer small herring of about 8 cm. length were found in very large shoals along the coasts of northern Jutland. Analysis of a sample of these from Hurup is shown in Table 13 together with that of three samples of herring from the fish for processing.

Table 14. Larger Herring from the southern Kattegat and the Belt Sea.

Sample	Date	Locality	Implement	Number examined	Number only measured
A	28.10.1947	Hundested	Pound net	180	131
B	24.11.1947	Off Flensborg Fjord	Trawl	180	67
C	1.12.1947	At Bogense	Pound net	179	193
D	9.5.1948	Hundested	Pound net	120	174

Maturities (%).									Length Distribution, cm. (%).												Total
Sample	I	II	III	IV	V	VI	VII	VIII	Mat.	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	
A	34	27	23	3	14	0.3	—	—	I, II, III, IV, V, VI	—	0.3	5	5	26	19	13	6	9	1	—	84
B	51	22	15	5	1	—	2	4	—	—	—	—	—	—	5	4	5	3	0.3	—	17
C	12	77	7	2	—	—	—	—	—	0.3	1	1	6	15	36	38	9	1	—	—	101
D	15	21	4	1	27	31	1	1	—	—	—	1	3	7	37	34	15	1	0.3	0.3	99

Number of Rings (%).										Racial Characters. In brackets: No. of specimens exam.				
Sample	Mat.	0	1	2	3	4	5	6	Total	Sample	Mat.	V. S.	V. P.	K ₂
A	I, II, III, IV, V, VI	5	33	22	8	9	5	2	84	A	I, II, III	55.80(142)	23.53	13.98(139)
B	—	—	4	6	3	1	2	1	17	—	IV, V, VI	55.92(38)	23.79	14.03(38)
C	0.4	48	38	11	2	1	0.4	—	101	B	—	55.68(180)	23.57	13.91(176)
D	4	87	7	2	0.3	—	—	—	100	C	—	55.81(179)	23.57	14.10(179)
	—	68	25	4	1	2	—	—	100	D	I, II, III	55.77(39)	23.51	14.18(38)
											V, VI, VII	55.70(80)	23.43	13.96(79)
											I—VIII	55.72(120)	23.46	14.03(118)

It is evident that the small herring from Hurup are autumn spawners from the northern Kattegat. The herring in the sample from Bogense are mainly Kobbergrund herring mixed with spring spawners from the Belt Sea. In other samples of small herring taken in October 1948 from the Aarhus Bay and Great Belt the racial characters proved them to be pure Kobbergrund fish.

The small herring from the southern Little Belt and the Western Baltic (Aabenraa Fjord and off Flensborg Fjord) were typical Belt Sea spring spawners.

Four samples of larger herring were investigated. From Table 14 it is seen that the herring caught in the autumn were mostly immature which is typical of recent years when the autumn herring have been very scarce in these waters. The racial analyses show that the immature herring are typical spring spawners. The spawning herring (the Hundested sample) have the V. S. and V. P. to be expected from the autumn spawners of the southern Kattegat but the extraordinary low K_2 must be due to the small number examined.

The herring of the various maturities caught in the winter and spring are typical spring spawners of the area.

There is as yet no sign that a good year-class of autumn spawning herring of the Belt Sea has appeared.

Aage J. C. Jensen.

Eel.

Limfjord. In 1948 the following numbers of eels were caught per 30 min. with the eel-tog, numbers in brackets denote the mean numbers for 1927—39.

	Nissum Br.	Venø—Kås	Sallings.
June	5.0(0.9)	3.3(0.7)	1.3(1.0)
Sept.	0.5(0.2)	0.8(1.5)	0.7(1.8)
Mean	2.8(0.6)	2.1(1.1)	1.0(1.4)
	Livø Br.	Thisted Br.	E. of Salling
June	2.2(1.1)	1.8(1.3)	0.3(1.2)
Sept.	1.8(2.5)	1.1(4.0)	2.7(2.8)
Mean	2.0(1.5)	1.5(2.8)	1.5(2.2)

Thus in June the number is considerably higher than normal, but, except in Nissum broad, far below normal in September.

Compared with the years since 1940 the stock has improved a little (1.8 against 0.9 per 30 min.), and the catch figure for 1948 is about the same as for the years 1927—39.

Erik M. Poulsen.

Isefjord. The density of the stock of eels seems to have been somewhat less than in 1947, although considerably greater than in the Limfjord in the inner parts of the fjord.

Prediction for the silver-eel fishery from the summer temperature of the water was published in Danish fishery journals in the beginning of September.

The 1947 catch was predicted to be 20 % greater than usual, a figure that was confirmed by subsequent landings.

Aage J. C. Jensen.

Fish for Processing.

The Danish fishery for fish-meal factories and fish pond food has been continued and shows a considerable increase.

Year	1946	1947	1948
Million Kg.	10.7	23.8	41.7

In 1948 the catch in the various waters was as follows:

	100 tons		100 tons
North Sea	14	Sound	0.2
Skagerak	223	Western Baltic	0.3
Kattegat	131	Baltic proper	3
Belt Sea	17	Limfjord	13

The greatest part was thus taken in the Skagerak and Kattegat and landed at the harbours of Skagen, Hirtshals and Frederikshavn.

During the year 13 samples from the Skagerak and the northernmost Kattegat were investigated. The following species were found and their relative abundance, by weight, is given:

	No. of samples	
	N. Kattegat	Belt Sea
	13	9
Whiting	60 %	54
Other codfishes	10 ¹⁾	24)
Herring	10	39
Sprat	7	4
Flat fishes	22)	}
Other species	11 ³⁾	

¹⁾ Poor cod: 1 %.

²⁾ Dab and long-rough dab.

³⁾ Mackerel, greater silver smelt, horse mackerel and Norway haddock.

⁴⁾ Cod and haddock.

In the Skagerak and the northernmost Kattegat this fishery is mainly concerned with small whiting, small herring and sprat. It consists partly of waste fish from the trawl fishery for herring, sprat and Norwegian shrimp and from a Danish-seine fishery for round fish. In the Belt Sea the greatest part consists of waste fish from the trawl fishery for herring and sprat.

J. B. Kirkegaard.

Marketable Crustaceans.

Lobster. Statistics from 26 fishermen fishing along the Skagerak coast gave, as in 1947, a mean of 6.2 lobster per trap.

Alf Dannevig.

Deep Sea Prawn.

In July and August experimental fishing was carried out in the Skagerak with the commercial prawn trawl, closed partly by means of the Norwegian closing along the hind margin of the bag and partly by means of the common Danish closing using a knot.

The mean sizes (measured from the front of the carapace to the hind point of the telson) of the prawns caught in various experiments were as follows.

Norwegian closing: 7.67 7.81 7.72 7.88 7.75 cm.
Danish closing: 8.20 7.55 8.03 8.09 cm.

Two of the experiments were made at the same place and date, and gave the following results:—

Norwegian closing	Danish closing
7.67 cm.	8.20 cm.
7.75 cm.	7.55 cm.

These experiments do not indicate that the Norwegian closing method results in a bigger mean size than the Danish method, but the experiments are few and the investigations will be continued. The prawn trawl used had meshes in the cod-end of 18 mm. from knot to knot.

In two cases fine-meshed cod-end was added to

the trawl in order to ascertain the number and size of the prawn passing through the bag of the trawl. The following measurements refer to the catch in the trawl and in the extra cod-end respectively:—

cm.:	3	4	5	6	7	8	9	10	11
extra cod-end	26	32	—	7	39	4	—	—	—
Trawl	—	26	—	11	195	85	35	34	6

It appears that only very few small specimens are taken in the trawl; that 19% of those between 6 and 8 cm. are released, and that above 9 cm. none are released.

Erik M. Poulsen.

Oyster.

Norwegian coast.

The oysters in the natural ponds thrived excellently, but the collecting of spat gave a poor result both in the sea and in the oyster pond at Flødevigen.

Alf Dannevig.

Limfjord.

The stock was investigated in July, and the Norwegian spat layed out in April showed a very great growth. At some places there were very considerable amounts of small oysters from natural hatching in the Limfjord during the later years. A considerable indigenous stock of marketable oysters was found at some places.

Investigations into the transplanting of oyster spat to the Danish Wadden Sea have been carried out.

H. Blegvad.

Baltic Area.

INTRODUCTION.

Contributions to this report have been received from Dr. Aage J. C. Jensen, Copenhagen; Miss A. Glowinska, Gdynia; Dr. Z. Mulicki, Gdynia; Dr. H. Alander, Göteborg; Dr. A. Molander, Lysekil; and Dr. N. Rosén, Göteborg.

Environment.

Glowinska calls attention to the strong influx of salt water into the Deep of Gdansk, which began in May 1947 and caused a gradual increase in the salinity of the bottom layers in this area until the middle of May 1948. This may be considered as a continuation of the exceptionally strong influx into the Bornholm Basin which was observed during the winter 1946—47.

According to Glowinska and Jensen the oxygen content seems to have been very low in the lowest strata of both the Deep of Gdansk and the Bornholm Basin during the greater part of 1948. In December that year, however, Alander found a comparatively high oxygen content in these strata in the Bornholm Area which he ascribes to a fresh influx of water from the Belts. The salinity is still high in the southern and south-eastern parts of the Baltic.

In the central Baltic, as well as in the Sea of Åland, the salinity seems to have been high in 1948 which may perhaps be due to an inflow of water into these areas from the southern Baltic. In other respects the hydrographic conditions in the inner parts of the Baltic seem to have been about normal during 1948.

Jensen has continued his observations on the fat content of the plankton and has found it to be very low, an average of only 9 %, in the Bornholm area, which is considerably lower than the corresponding value in any of the years 1942—47.

Fish Species.

According to Alander the stock of **cod** in the different parts of the Baltic is still very strong, due

to the presence of some good year-classes. Alander is of the opinion that there has also been a big movement of cod into the Baltic. As a matter of fact the stock of cod and the cod fishery in the Baltic has reached such a level that this area must now be considered as one of the most important cod-fishing centres of Europe. It is of interest that, according to Alander, the quality of the cod in the central Baltic, which for several years has been rather inferior, has now improved. Alander draws attention to the fact that whiting and mackerel are now unusually common in the Baltic, and he is of the opinion that the latter species also has hibernated in the Bornholm area. He has also found that the sprat is now much more abundant along the Swedish coast of the Bothnian Sea than in previous years.

Jensen and Molander have made the usual investigations on the abundance of the young bottom stages of **plaice**, **flounder**, and **turbot**, along the Danish and Swedish coasts of the southern Baltic. The 0-group plaice were fairly numerous and more abundant than in 1947. The same was true for the 0-group flounder, at least at some localities. The 0-group turbot, on the other hand, were scarce.

Mulicki has for the first time carried out similar investigations on the Polish coast. Moderate catches of 0-group flounder and turbot were obtained on the coast of the Gulf of Gdansk but none were found on the open coast.

Jensen has analysed three samples of **herring** from the Bornholm area. Because of the value of VP and K₂ in these samples Jensen assumes that they consist partly of spring spawning herring spawning elsewhere than in the Bornholm area, probably on the southern coast of the Baltic where these values are as yet unknown.

Alander has found that the greater part of the herring stock in the central Baltic as well as in the Bothnian Sea consists at present of spring spawners. This statement is of interest because it indicates that the relative frequency of the spring spawners and the autumn spawners can vary a great

deal. Earlier investigations have shown that autumn spawners have been dominating for long periods.

Of special interest is Alander's statement that there is now a considerable stock of spring spawners in the Bothnian Sea which shows the same racial characters as the spring spawners in the central Baltic. All the spring spawners in the Bothnian Sea, "the ice-herring", were formerly of a type rather different from the spring spawners in the central Baltic.

In the innermost part of the Gulf of Bothnia, the Bothnian Bay, it is hardly possible to distinguish spring spawners from autumn spawners. The herring in this area has only one spawning season and may be characterized as summer spawning.

The herring stock in the Baltic has been very weak for several years but it now seems to be recovering, owing to a better recruitment during recent years.

Rosén presents a graph illustrating the enormous increase in the Swedish and Danish **salmon** catches in the Baltic during the last five or six years, and asks whether the present condition of the salmon fishery makes it advisable to limit this fishery in the Baltic. As, however, the Salmon and Trout Committee is dealing with this problem it will not be discussed here.

General Remarks.

If one looks upon the results of the investigations in the Baltic as a whole during recent years one gains the impression that the abundance of marine fish in this area has greatly increased. Thus the stock of cod has continually grown and is now very strong. Such species as whiting and mackerel, which previously were regarded as occasional guests in this area, are now met with regularly and often in great numbers. The sprat also occurs in the Gulf of Bothnia in comparatively large shoals. These changes in the fish fauna are of course due to changes in the hydrographic conditions, investigations having shown for example that the salinity of the water in the Baltic has increased during the last few years. It is possible that these changes in hydrographic conditions have caused, directly or indirectly, the changes in the composition and racial characters of the herring stock that seem to have taken place during recent years.

The great increase in the stock of salmon, on the other hand, is certainly not caused by the present hydrographic conditions in the Baltic. It may however, be possible that the same major climatic conditions have been favourable both for the salmon and for the marine fish species in the Baltic.

Chr. Hesse.

ENVIRONMENT.

Hydrography.

Danish Observations.

Table 1. Monthly Means of Temperature and Salinity at Surface at Christiansø, N. of Bornholm.

(From the Danish Meteorological Institute. Nautical Department).

1947	X	XI	XII	1948	I	II	III	IV	V	VI	VII	VIII	IX
Temp.	12.9	8.8	5.9	—	2.4	2.4	4.1	7.4	12.9	16.9	18.3	15.5	
Sal. ‰	7.3	7.4	7.4	—	7.1	7.2	7.2	7.3	7.6	7.6	7.4	7.5	

Helge Thomsen.

Observations taken between the 8th and 15th September 1948 showed the warm upper layer to be unusually deep with temperatures mainly above 15°C. down to 25 m. depth. At 90—95 m. depth about 2 sea-miles south-east of Christiansø the salinities and temperatures were a little lower than those found by Alander in the Bornholm area in September and December 1947 (Ann. Biol. IV, p. 139), obviously on account of a slow mixing with the upper layers, but the oxygen contents which in September were about 4 c.c. per l. and in December about 3 c.c. were now 0.32 c.c. per l. (see Table 2).

Table 2. Hydrographic Data, Christiansø, 10.9.1948.

Depth, m.	Temp., °C.	Salinity, ‰	Oxygen, c.c.m.
0	16.6	—	—
20	16.6	—	—
25	16.6	7.4	—
30	8.3	7.4	—
35	6.7	—	6.58
40	6.4	7.6	—
45	6.5	7.9	6.57
50	5.8	9.3	5.62
55	7.0	—	—
60	6.7	13.2	4.25
65	6.7	13.2	4.18
72	7.3	16.4	0.92
75 ¹⁾	7.4	16.7	0.67
83 ¹⁾	7.4	—	—
90	7.4	16.8	0.32
95	7.4	17.0	0.32

¹⁾ 4 sea-miles N. of Christiansø.

3 sea-miles NE. of Svaneke gave the following data at a depth of 67 m.: t, 7.3; s, 16.9; oxygen, 0.21 c.c. (13/9 1948).

The low oxygen contents caused fish (cod) to die in the trawls if they came into the areas where the depth was more than 70—80 m. during a haul. Some of the fishermen believed the death to be caused by the poison gas thrown out by the Russians about 20 sea-miles to the east of Christiansø.

Aage J. C. Jensen.

Observations off the Polish Coast, 1947 and 1948.

The accompanying Table 3 gives data on the temperature and salinity at the fixed station G₂ in the Gulf of Gdansk (54°53'3 N.; 19°22'E.) for the period from 11.IV.47 to 30.VII.48. Figure 1 presents the variation of temperature, salinity and oxygen content from 18.VI.46 to July 1948.

1. The inflow of salt bottom water into the Deep of Gdansk.

As can be seen from Figure 1 the inflow of salt bottom water began on 29th May 1947, when the salinity at the bottom became appreciably higher in comparison with that of the preceding period. During the following months the salinity near the bottom gradually increased until 15th May 1948, when it reached the maximum value of 13.73 ‰.

The temperature in May 1947 suddenly dropped from about 5°C. to 2.3°, but from September it was increasing slowly until January 1948, reaching 7.9°C. From then until 30th July the temperature remained more or less constant.

Parallel with the increase in salinity and lowering of the temperature in May 1947, the oxygen content of the bottom water suddenly rose from about 20 ‰ to over 70 ‰ saturation (by volume). The high oxygen content (50—70 ‰) lasted until

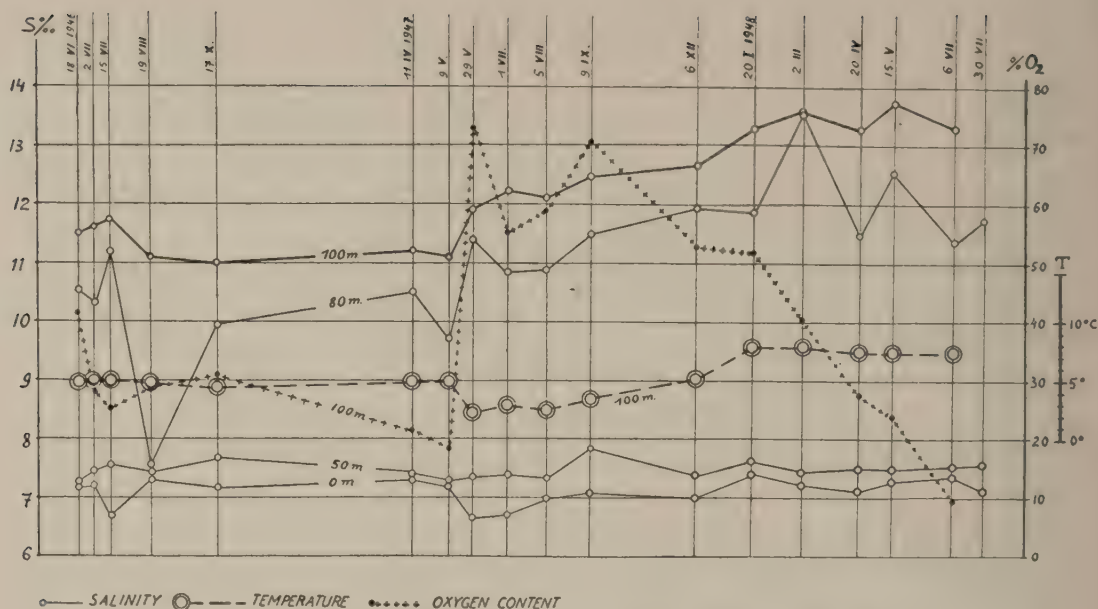


Fig. 1. Variation of Temperature, Salinity, and Oxygen Content in 1946—1948.

Table 3. Temperature and Salinity Data for the Station G₂, Gulf of Gdansk.

Depth m.	11.IV		9.V		29.V		1947 1.VII		5.VIII		9.IX		6.XII	
	T	S	T	S	T	S	T	S	T	S	T	S	T	S
0	0.4	7.32	3.7	7.20	10.0	6.65	22.7	6.69	19.0	6.98	16.6	7.09	6.6	7.03
5	0.4	7.32	3.5	7.23	10.0	6.69	17.3	6.85	18.6	7.00	16.5	7.11	6.7	7.09
10	0.4	7.38	2.3	7.23	7.5	6.98	12.6	6.93	18.2	7.02	16.2	7.23	6.8	7.11
20	0.2	7.41	2.5	7.23	3.7	7.23	3.2	7.11	7.7	7.00	10.5	7.29	6.9	7.14
30	0.3	7.41	2.1	7.25	2.4	7.20	3.3	7.30	2.6	7.21	3.9	7.41	7.0	7.18
40	0.2	7.41	1.9	7.25	2.0	7.34	1.8	7.32	2.6	7.32	3.4	7.52	7.0	7.20
50	0.2	7.41	1.6	7.30	1.6	7.34	2.2	7.41	1.9	7.36	3.8	7.86	6.8	7.41
60	0.6	7.90	0.5	7.50	1.7	9.81	3.1	9.06	1.8	8.17	3.5	8.57	3.4	9.45
70	4.5	9.87	0.5	7.77	3.8	9.80	4.3	10.14	3.7	10.17	3.1	10.19	3.7	11.13
80	4.8	10.52	4.1	9.74	4.4	11.40	4.4	10.86	4.4	10.91	3.2	11.51	3.4	11.96
90	5.0	10.84	4.9	10.93	2.8	11.46	2.6	11.35	2.8	11.44	3.3	12.32	5.4	12.54
100	5.0	11.22	5.0	11.13	2.3	11.92	2.7	12.25	2.4	12.12	3.4	12.48	5.3	12.67

Depth m.	20.I		2.III		20.IV		15.V		6.VII		30.VII	
	T	S	T	S	T	S	T	S	T	S	T	S
0	3.5	7.38	1.5	7.21	5.9	7.11	8.4	7.27	15.2	7.36	21.4	7.12
5	3.5	7.38	1.6	7.21	5.8	7.11	8.4	7.27	15.1	7.36	20.9	7.18
10	3.5	7.38	1.6	7.21	4.5	7.29	7.7	7.27	14.2	7.39	18.5	7.29
20	3.5	7.38	2.1	7.39	3.2	7.36	5.1	7.38	12.3	7.41	13.7	7.29
30	3.6	7.43	2.2	7.39	2.8	7.39	4.3	7.38	7.7	7.45	7.6	7.41
40	3.7	7.57	3.0	7.57	2.6	7.45	3.1	7.43	6.4	7.54	6.0	7.47
50	4.3	7.61	2.7	7.45	2.4	7.47	2.6	7.47	4.7	7.54	4.6	7.56
60	4.3	7.97	4.2	9.96	2.5	7.57	3.2	8.46	3.1	7.74	3.3	7.95
70	4.2	9.78	6.5	11.69	4.3	9.94	4.9	10.64	4.0	9.63	4.2	10.01
80	6.9	11.89	7.9	13.55	6.0	11.49	6.9	12.32	5.3	11.37	5.6	11.71
90	7.7	13.08	7.9	13.59	7.2	12.72	7.4	13.10	7.0	12.86	6.7	12.77
100	7.9	13.28 ¹⁾	7.9	13.59	7.5	13.28	7.5	13.73	7.4	13.30	7.0	12.92 ¹⁾

¹⁾ at 96 m. depth.

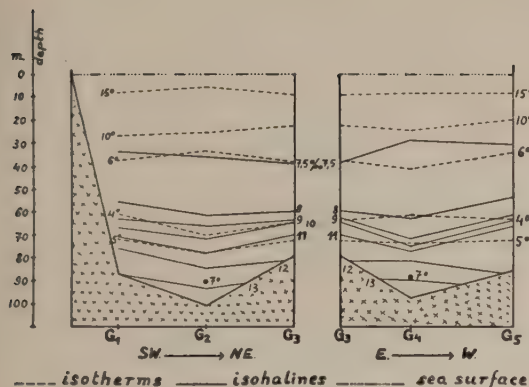


Fig. 2. Hydrographic Sections.

20th January 1948, when the water temperature reached about 8°C. From then onwards the salinity remained high, and so did the temperature, but the oxygen content rapidly dropped to 9.64 ‰ saturation, the value observed on 6th July 1948.

The data of the salinity of the upper 50 m. stratum during the whole period from 18.VI.46 to 30.VII.48, given in Figure 1, showed no great changes and did not exceed the limits 6.65–7.86 ‰. The observations on the changes of temperature and salinity should also be continued in the other regions of the Baltic Sea, especially in its western part.

2. The paths of isotherms and isohalines on 6–7th July according to data from stations G_1 – G_5 are shown on Figure 2. The positions of the stations are as follows:

	N.	E.		N.	E.
G_1	54°42'	19°00'	G_4	55°3'	19°17'
G_2	54°52'	19°22'	G_5	55°2'7"	18°47'
G_3	55°2'7"	19°34'			

(The positions are the same as in Fig. 1 of A. Glowinska, Hydrography off the Polish Coast, Ann. Biolog. Vol. III (1946). 1948.)

A. Glowinska.

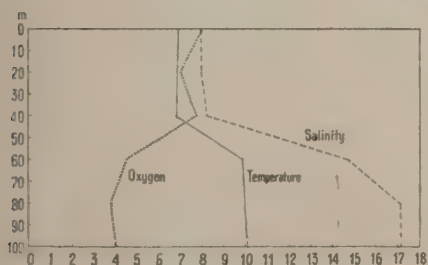


Fig. 3. East of Bornholm, December.

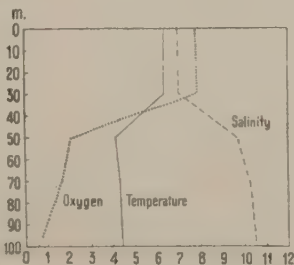


Fig. 4. West of Visby, November.

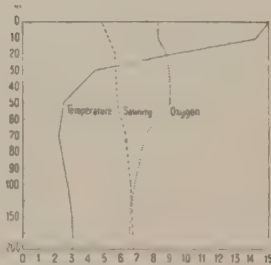


Fig. 5. Bothnian Sea, August.

Swedish Observations.

In 1948 the hydrographic observations carried out with the research ship "Eystrasalt" were chiefly confined to the central Baltic and to the Bothnian Sea and the Bothnian Bay.

Of the observations in the southern Baltic only one is of special interest. In December the temperature as well as the salinity in the deep parts of the Bornholm area was very high (Fig. 3). This may be the result of the influx of extremely warm and salt water in 1947, but the comparatively high oxygen content of the bottom water indicates that there has also been an influx of water from the Belts.

The salinity of the bottom water in the central Baltic was still high, more than 10.5 ‰. The temperature, too, was rather high, about 4.5°C., which indicates that, in this respect, conditions are now "normal" again after the cold period in the early forties (Fig. 4). The oxygen content in the strata near the bottom in the waters west of Gotland is usually very low, and this was the case in 1948. In recent years the boundary between the strata with high oxygen content and the bottom water has been very sharp, and was usually found between 50 and 70 metres. In the late autumn of 1948, however, the oxygen content was higher than normal at 70 metres but lower than normal at 50 metres. This fact may be due to a mixing of the intermediate water masses caused by the heavy gales in the autumn 1948.

In the Sea of Åland water with a salinity of 8 ‰ was observed in September at a depth of 200 metres, which indicates a very strong influx of water from the central Baltic, probably in connection with strong currents caused by the stormy weather.

In the Bothnian Sea, however, the salinity was comparable to that of previous years, but the temperature was considerably higher. In the Ulvö Deep, in the northern part of this area, the temperature at the bottom was one degree higher than in 1947 (Fig. 5). This fact is no doubt caused by the warm summer of 1947.

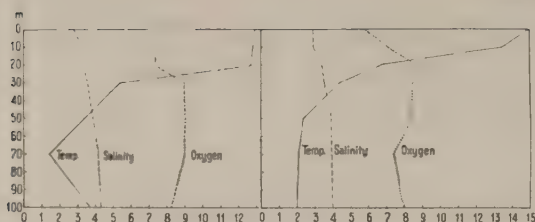


Fig. 6. Southern Part. Fig. 7. Northern Part.
Temperature, Salinity, and Oxygen Content in the
Bothnian Bay, August 1948.

In the Bothnian Bay also the temperature was higher in the bottom water than in previous years. In the southern part of that area the temperature at 100 metres was as high as $3.7^{\circ}\text{C}.$, which is about three degrees higher than the corresponding value in 1947 (Fig. 6). In the northern part of the Bothnian Bay the temperature at the bottom was about $2^{\circ}\text{C}.$, which must be considered as remarkably high (Fig. 7).

As far as the salinity of the Bothnian Sea and the Bothnian Bay is concerned no noteworthy changes seem to have appeared in 1948. The oxygen content has also been found to be normal.

Harald Alander.

THE FISH.

Cod.

In the Bornholm area the stock of cod is very abundant, chiefly owing to the strong year-classes from the early forties. After a few years with decreased recruitment to the stock, some strong year-classes have again appeared and at present there seems to be no danger of a decrease in the stock of cod. The trawl-fishery still makes very big catches which may be due to some extent, however, to improved fishing gear, but there is no doubt that the stock of cod has increased. This conclusion is based on the fact that the long-line fishery, despite the fear of depletion by the trawlers, yields better catches than ever.

The stock of cod in the central Baltic has been very large for many years, but the individual cod have been extremely thin and in bad condition. Only a very small proportion of the catches could, in fact, be regarded as consisting of fish in good condition. In 1948 a sudden change seems to have taken place. In the waters off Gotland, as well as in the archipelago of the central Baltic, cod of excellent quality have been caught in large numbers.

In the Sea of Åland, however, the cod in previous years was generally of an extremely good quality, but in 1948 a considerable proportion of the catches consisted of lean cod.

Plankton.

Conditions at Bornholm.

The fat content of the plankton has been determined by the fishery-industrial laboratory of the Danish Fisheries Ministry. The samples were taken with the Hensen net in vertical hauls usually from bottom to surface.

The following values were found 8.—15. Sept.:

Position	depth, m.	hauls, m.	fat %
2 sea-miles E. of Nexø	38	22—0	11.5
2 sea-miles NE. of Gudhjem	46	44—0	6.1
6 sea-miles E. of Allinge	63	60—0	8.9
3 sea-miles E. of Nexø	62	58—0	9.6
$5\frac{1}{2}$ sea-miles ESE. of Nexø	67	65—0	10.5
$5\frac{1}{2}$ sea-miles ESE. of Nexø	67	65—25	10.6
$5\frac{1}{2}$ sea-miles ESE. of Nexø	67	25—0	8.1
3 sea-miles NNE. of Hammeren	59	57—0	6.7

The average is 9%, while in Aug.—Sept. of the years 1942—47, 16, 25, 33, 16, 15 and 15%, respectively, were found.

Aage J. C. Jensen.

Harald Alander.

Whiting.

In the autumn of 1947 small whiting, chiefly of the 0-group, appeared in the southern Baltic in large numbers, probably as a consequence of the strong influx of water from the Kattegat that took place in that year. In 1948 the stock of whiting was still so large that the number of whiting in the catches often exceeded that of small cod.

Harald Alander.

Flat Fishes.

Danish Investigations.

The abundance of 0-group and I-group fish was determined by quantitative hauls with the Johansen young-plaice trawl at depths of $1-1\frac{1}{2}$ m., and at Bornholm by quantitative hauls with the hand push-net at depths of $\frac{1}{2}-1$ m.

Table 4. Abundance of 0-group Plaice, Flounder and Turbot on the Baltic Area Coasts of Denmark.Number caught per 30 minutes during June—Sept. 1948.
(Mean for 1928—47).

Coasts of	Gear ¹⁾	Year	No. of stations	Plaice	Flounder	Turbot
Sjælland, Møen and Falster	Y	1948	11	1	14	0.0
		Mean	—	3	239	0.3
	Y	1948	3	25	49	0.0
		Mean	—	13	45	6
Bornholm	H	1948	9	12	44	5
		Mean	—	8	130	12

¹⁾ Y: Young-plaice trawl; H: Hand push-net.

The frequency of 0-group plaice varied from one part to another of the Kattegat, Belt Sea, and Baltic; but on the whole it seems to have been above normal, corresponding to the high winter and spring temperature.

The I-group plaice were scarce. In hauls with the young-plaice trawl at Bornholm only 1 was caught at one of the stations, and none on the Sjælland, Møen, Falster coasts.

*Age J. C. Jensen.***Swedish Investigations.**

Fishing with the Johansen young-plaice trawl was carried out at depths mostly between $\frac{1}{2}$ and 2 m. during July 1948 (see charts pp. 122 and 123).

Table 5. Abundance of 0- and I-group Plaice, Flounder and Turbot on the Baltic Coasts of Sweden.

Number caught per 30-minute haul with the Johansen young-plaice trawl. (Mean for 1929—38).

Number of stations	Southern Scania		Eastern Scania		Blekinge	
	13		11		3	
Year	0-Gr.	I-Gr.	0-Gr.	I-Gr.	0-Gr.	I-Gr.
Plaice						
1947	0.2	0.2	0	0.3	0	0
1948	15	1	10	—	0	0
Mean	37	7	2	6	0.2	0.3
Flounder						
1947	32	5	45	5	32	63
1948	93	21	175	39	43	128
Mean	101	50	36	17	153	119
Turbot						
1947	0.4	0	3	0	5	0
1948	0	0.3	0	0	0	0
Mean	4	1.1	3	0.5	5	0.6

Both on the south and east coasts of Scania the catches of 0-group plaice were larger in 1948 than in 1947, and the catch on the east coast was better than the mean for 1929—38.

0-group flounders were more numerous throughout 1948 than 1947, especially on the east coast of Scania where the catch was above the mean for 1929—38.

0-group turbot, which in 1947 were relatively frequent, were virtually non-existent in 1948 and I-group fish were very scarce.

*Arvid R. Molander.***Investigations on 0-group Flat Fish on the Polish coasts.**

In 1948 the investigations on the abundance of young flat fish on the coasts of Poland were begun for the purpose of assessing the relative recruitment of the young of these fish in each year.

Fishing was accomplished by the use of the standard hand push-net, with a frame 75 cm. broad at the base. Five stations were worked, i.e., near Swiezy Haff (German Frisches Haff), Gdynia, Rewa, Wladyslawowo and Kolobrzeg. The fish were caught on the coast in depths from 0.8—1.5 m. The number of 0-group flounder and turbot caught by 1 man per hour, as well as the locality of stations are given in Fig. 8. It may be seen that the stations

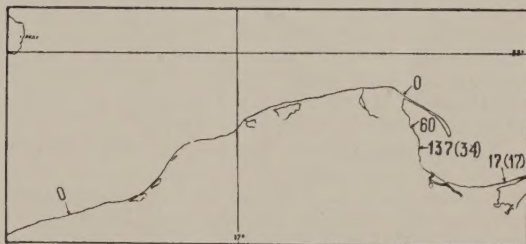


Fig. 8. Number of 0-group Flounder and Turbot () caught with hand push-net, 1 man per hour.

situated in calm places in the Gulf of Gdansk gave the best results. In stations situated on the open coast (Kolobrzeg and Wladyslawowo) no flat fish was caught, nor were plaice or dabs caught at the stations near Swiezy Haff, Gdynia, or Rewa.

In comparison with the Danish catches (1932—1945) using the push-net around Bornholm, amounting to an average of 266 flounders and 34 turbot per hour, it can be seen that the catches near the Polish coasts are much poorer.

*Z. Mulicki.***Herring.****Swedish Investigations.**

The Swedish investigations on the Baltic herring have been carried out chiefly in the central Baltic

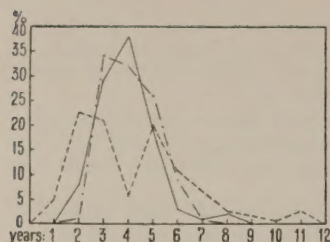


Fig. 9.

— Southern part of the Bothnian Sea, Sept.
 - - - Spring Spawners, Södermanland, Central Baltic, Nov.
 - · - · - Northern part of the Bothnian Sea, July.

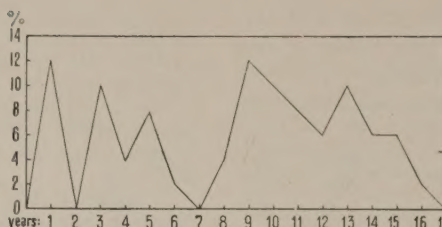


Fig. 10. Off Gävle, May.
 (Caught with trawl.)

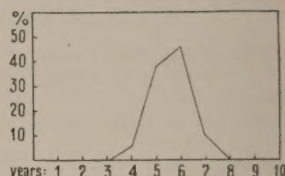


Fig. 11. Bothnian Bay.

Age-Composition of Herring in 1948.

and in the Gulf of Bothnia. As in previous years most of the catches have been obtained with herring nets, but the herring trawl has been used more extensively than before.

In the central Baltic the stock of herring now consists principally of spring spawners, but in some cases autumn spawners also have appeared in the catches. Of a catch at Knoll's Grund, between Gotland and the mainland, at the beginning of June, 84 % were autumn spawners of the 1943 year-class. These autumn spawners have a comparatively high number of vertebrae, about 55·8. At the same locality the spring spawning of the herring continued until the end of June in 1947, but in 1948 it finished several weeks earlier, which may be explained by the fact that the warming up of the water took place very early in 1948.

In November 1948 herring in large shoals entered the archipelago of the Swedish east coast and could easily be followed by the echo-sounder, but no catches could be obtained in the herring nets. Experimental trawling, however, gave very large catches of spring spawners. The age-composition of the catches is shown in Fig. 9. The stock of herring consists principally of some comparatively strong year-classes of which those of 1943, 1944, 1946 and 1947 seem to be the most important. It may be mentioned that a racial investigation of the catches suggests that there is a form intermediate between that of the archipelago and that of the open-sea fish. The herring from the firths of the central Baltic generally has a vertebral count of about 55·2, whereas the herring from the open sea, between Gotland and the mainland, has a larger number of vertebrae, viz. 55·5. But the spring spawners in catches made in 1948 gave a vertebral count of about 55·4. Possibly this is a special group of herring belonging to the outer parts of the archipelago.

Spring spawners form the principal part of the stock of herring in the Bothnian Sea also, since the old autumn spawners of the 1937 and 1938 year-classes have gradually disappeared. According to

earlier investigations, the spring spawners of the Bothnian waters, the "ice-herring", spawned very early in spring and were characterized by a large number of vertebrae, viz. 55·7. The spring spawners of the catches from 1948 seem to spawn later in the year and have a smaller number of vertebrae, viz. 55·4, thus resembling the spring spawners from the outer archipelago of the central Baltic. The age-composition of the catches from the southern as well as from the northern parts of the Bothnian Sea indicates that the year-classes 1944—1946 have been strong (Fig. 9).

A catch made with a trawl at a depth of 50—60 metres off Gävle in the southern part of the said area contained a mixture of different forms of herring, spring spawners as well as autumn spawners. There have been certain difficulties in allocating the herrings in this catch to their respective races, but the age-composition of the catch was of great interest, since, as shown in Fig. 10, there was a high percentage of very old herring. This confirms the observations of previous years that the herring, when growing old, avoids shallow water and spends most of its life in deep water.

The same type of spring spawners forms the main part of the stock in the Bothnian Bay as in the Bothnian Sea and the central Baltic. The number of vertebrae is the same and the scales are of the same shape, but the spawning occurs later and is often extended over the whole summer, so that some of the "spring spawners" are found spawning at the same time as the first autumn spawners. The age-composition of a catch from the outer archipelago off Piteå in the northern part of the Bothnian Bay shows that the 1943 and 1944 year-classes form the main part of the stock. (Fig. 11).

Harald Alander.

Danish Investigations.

Three samples of herring were examined, their length distributions being shown in Table 6 and

Table 6. Length distribution of Herring samples examined in 1948.

Locality	Date	16	17	18	19	20	21	22	23	24	25	26 cm.
Sorte Grund	10./6.	—	—	—	0.8	5.0	9.2	14.2	29.2	22.5	15.0	4.2
S.E. of Bornholm	31./8.	0.4	3.9	8.2	19.8	24.1	20.3	6.5	7.8	7.8	1.3	—
W. of Bornholm	11./10.	—	—	0.6	1.1	3.1	10.6	12.3	28.0	28.6	11.8	3.1

their maturities in Table 7. The length distribution of the June trawl-caught sample was the same as that of the October net-caught sample, 71 %, consisting of herring of 23 cm. and above, while of the August trawl-caught fish only 17 % fell into this length range.

From Table 8, showing the racial characters, it is seen that the K_2 of the immature and mature herring in the August fish differs appreciably from the K_2 of the mature herring caught in October.

Comparing the K_2 figures of the August and October samples gave a mean difference of 0.48, which was more than four times the standard deviation of the samples, viz., 0.112, and may therefore be taken as significant.

The number of immature and maturing herring examined in the June sample was small (17 specimens) and in the table they have been added to the spawning and just spent fish. It is seen that the K_2 figure of these herring is about the same as that of the recovering spents. The spawning, just spent, and recovering spents of this sample had a K_2 value of 13.87, a difference of 0.34 from the K_2 of the mature herring in the October samples, or about 3 times the standard deviation of 0.119. In this case also the difference therefore seems to be significant.

The herring of maturity VIII caught in June are probably autumn spawners, although their K_2 figure is rather small. In fact, the difference in their K_2 values from the mean found for the herring in the October sample, was only 0.29, a little more than twice the standard deviation of 0.13, and was therefore not significant. On the other hand the K_2 of the other maturities II, III, IV, VI, VII, is 0.39 less than the K_2 of the October sample, a difference which is more than 3 times the standard deviation of 0.12.

It is probable that the June and August samples consist of both spring and autumn spawning fish.

From the extensive investigations of Hessel we know that the spring spawners along the Baltic coasts of Sweden have a lower K_2 and a lower V.P. than the autumn spawners. In view of the fact that the herring in our June and August samples have about the same V.P. as the autumn spawners (but a lower K_2), it must be assumed that they belong to a stock of spring herring spawning elsewhere, most probably along the southern coast of the Baltic where the V.P. and K_2 values are unknown.

Aage J. C. Jensen.

Sprat.

The stock of sprat in the central Baltic is of moderate strength only. In some cases, however, good catches have been obtained in the open sea during the spawning period. The majority of the fish in the catches were 3 years old. In the Bothnian Sea off the Swedish coast the stock of sprat in recent years has become unusually strong and has had some influence on the composition of the commercial herring catches, to which the contribution of sprat in some cases has been as great as about 10 %. In July, spawning sprat were found as far north as the vicinity of Ulvö in the northern part of the Bothnian Sea.

Harald Alander.

Mackerel.

Mackerel enter the Kattegat in spring and return to the Skagerak and the North Sea in autumn. A small part of the stock, however, generally penetrates to the waters west of Bornholm in the Baltic. In 1948 this migration seems to have been

Table 7. Herring maturities %.

Date	Gear	I-II	III	IV	V	VI	VII	VIII
10./6.	Trawl	6.7	1.7	5.8	—	5.8	8.3	71.7
31./8.	"	59.1	12.5	—	3.4	15.9	—	9.1
11./10.	Net	—	0.6	—	66.5	22.4	9.3	1.2

Table 8. Racial characters (number examined: in brackets).

Date	Maturity	V. S.	V. P.	K_2
10./6.	II, III, IV, VI, VII	55.38 (34)	24.00 (34)	13.82 (33)
	VIII	55.58 (86)	24.12 (86)	13.92 (85)
31./8.	I, II, III	55.50 (86)	24.01 (86)	13.73 (86)
	V, VI	55.57 (21)	23.90 (21)	13.71 (21)
	VIII	55.2 (11)	23.7 (11)	13.5 (11)
11./10.	(III), V, VI, VII, (VIII)	55.53 (118)	23.93 (118)	14.21 (116)

extended farther than usual into the Baltic, and probably a part of the stock has remained there. The fact is, however, that in December mackerel were caught by trawls in the deep waters east of Bornholm and at the same time small mackerel appeared in the herring-net catches in the waters off Gotland.

Harald Alander.

Salmon.

The following diagram, Figure 12, gives a review of the Swedish catches of salmon in the Baltic during the period 1920—1948. The landings fluctuated in the nineteen twenties and thirties between about 100 and 400 tons. From this level there was a steady increase to 1,500 tons in 1946, but then followed, in 1947 and 1948, by a drop to about 1,200 tons. This great increase is, without doubt, due partly to the presence of one or two good year-classes, but also to an intensified fishing in the open sea. The Swedish salmon fishing in the Baltic is carried out partly along the coast, with seines, set nets, swing nets, traps, and bag nets, and partly in the open sea. Until 1948, however, this open sea fishing was carried on mainly with drift-nets and short swing lines, but in 1948, many fishermen began to use very long drift lines with snoods of nylon. This fishing was very effective and will probably become the most important fishing method in the open sea, at least so long as the stock of salmon is good. The question arises as to whether this new fishing method will reduce the stock to too

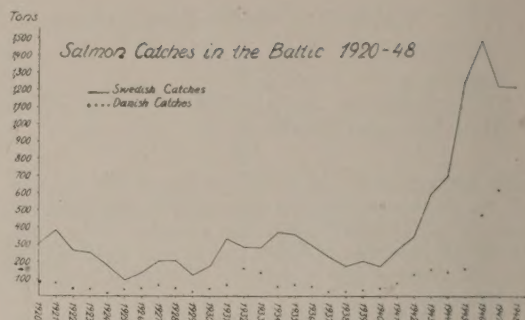


Fig. 12.

low a level. It may, for example, be advisable to try to limit the fishing in the open sea. If, on the other hand, the heavy catches are due mainly to some good year-classes, the intensive fishing in the open sea will probably slacken off as soon as these year-classes have passed, without any restrictions on the fishing being necessary. The question is of international interest. From the diagram it will be seen that the Danish catches show a similar increase, but this did not begin until the year 1946, when the yield rose from about 150 to 470 tons. Unlike the Swedish fishing, however, the Danish landings continued to increase in 1947 and in 1948, reaching a figure in that year of about 800 tons.

Nils Rosén.